Beech Landing Gear Primer

Part 4: "Magic Hand" Landing Gear Safety System

by George Brown

Marketed by Beech as the "Magic Hand," the Beech Landing Gear Safety System was intended to prevent gear-up landings as well as premature or inadvertent gear retraction. Introduced during the 1965 model year, Magic Hand was available as a factory-installed option on the ABS types of aircraft listed below:

- *Bonanzas/Debonairs* — S35 beginning with D-7842, V35, V35A, V35B, C33 beginning with CD-895, E33, E33C, F33, F33A, F33C, G33, 36/A36 (E-1 through E-2110 except E-1906 and E-2104), and A36TC
- *Travel Airs/Barons* — D95A beginning with TD-680, E95, B55 (TC-1024 through TC-1607), C55 beginning with TE-252, D55, E55, and 58 (TH-1 through TH-384)

Although the *Bonanza Model 35 Series Shop Manual* states the Landing Gear Safety System was available on all Bonanzas beginning with the original Model 35, marketing and manufacturing information plus the *Pilot's Operating Handbook* (POH) or *Owner's Manual* for a number of the ABS-type aircraft confirm the system was not available until the 1965 model year.

Several Bonanza and Baron models or serial number ranges are excluded from aircraft that could be equipped with the optional Magic Hand system. These aircraft include the later A36 (E-2111 and after), B36TC, G36, later B55 (TC-1608 and after), later 58 (TH-385 and after), 56TC/A56TC, 58TC, 58P, and G58.

As stated in the Limitations section of the Landing Gear Safety System POH supplement for relevant aircraft, "This system is to be used as a safety backup device only; normal use of the landing gear

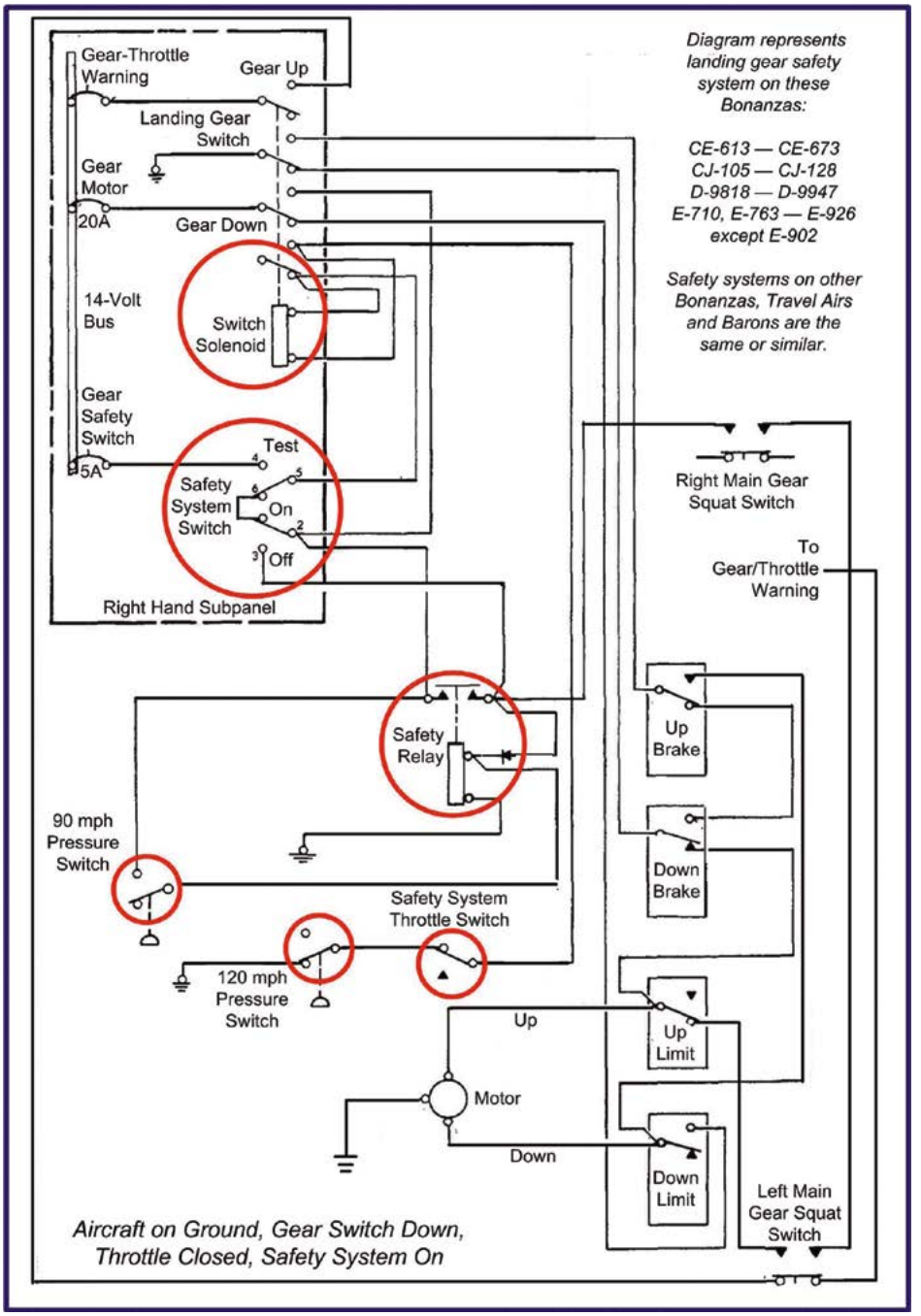

Figure 1: "Magic Hand" Safety System circuit diagram

position switch is mandatory." Part numbers for the appropriate supplement covering the Landing Gear Safety System are 35-590110-13 for Bonanzas and Debonairs and 130598 for Travel Airs and Barons.

Safety System Description

Basically, the Beech Magic Hand safety system consists of several switches plus a relay and solenoid implemented within the standard 14- and 28-volt landing gear electrical systems. When set to ON, the safety system automatically operates the landing gear position switch to extend the gear or controls electrical power to the landing gear motor to retract the gear. We described the landing gear system design and operation in parts 1 through 3 of the "Beech Landing Gear Primer" (see the January, June, and August 2021 issues).

The Magic Hand components include those listed below and encircled in red in **Figure 1**, which depicts the landing gear electrical circuit in model year 1976 Bonanzas. Safety system wiring diagrams for the other pertinent Bonanzas, Travel Airs, and Barons are either identical or analogous.

- *Switch solenoid* — part of the pilot's landing gear position switch assembly that is exclusive to the Magic Hand system. The solenoid is mechanically connected to the landing gear position switch and when energized, pulls the gear switch from the gear-up to the gear-down position.
- *Safety system switch* — three-position (on/off/test) adjacent to the pilot's landing gear position switch. The safety system will function when the switch is ON; when OFF the system does not provide any safety backup. A few of the later safety systems are equipped with on/off and press-to-test switches.
- *Safety relay and diode* — controls the 14- or 28-volt power to landing gear motor to retract the gear. The relay is mounted on the aft side of front spar carry-through structure and is part of gear-up electrical circuit.
- *Safety system throttle switch (single-engine)* — a microswitch in the gear-down electrical circuit that closes with a throttle setting of approximately 18 inches and lower manifold pressure. This switch is adjacent to the standard throttle position warning switch inside the engine compartment.

  or
- *Safety system throttle switches (twin-engine)* — two microswitches wired in series within the gear-down electrical circuit that close at approximately 17 inches and lower manifold pressure. Each switch is behind the instrument panel and adjacent to the standard position warning switch for the respective throttle lever.
- *90 mph pressure switch (single-engine)* — aneroid pressure switch in the gear-up electrical circuit that closes at airspeed of 90 mph (78 kts) and higher.

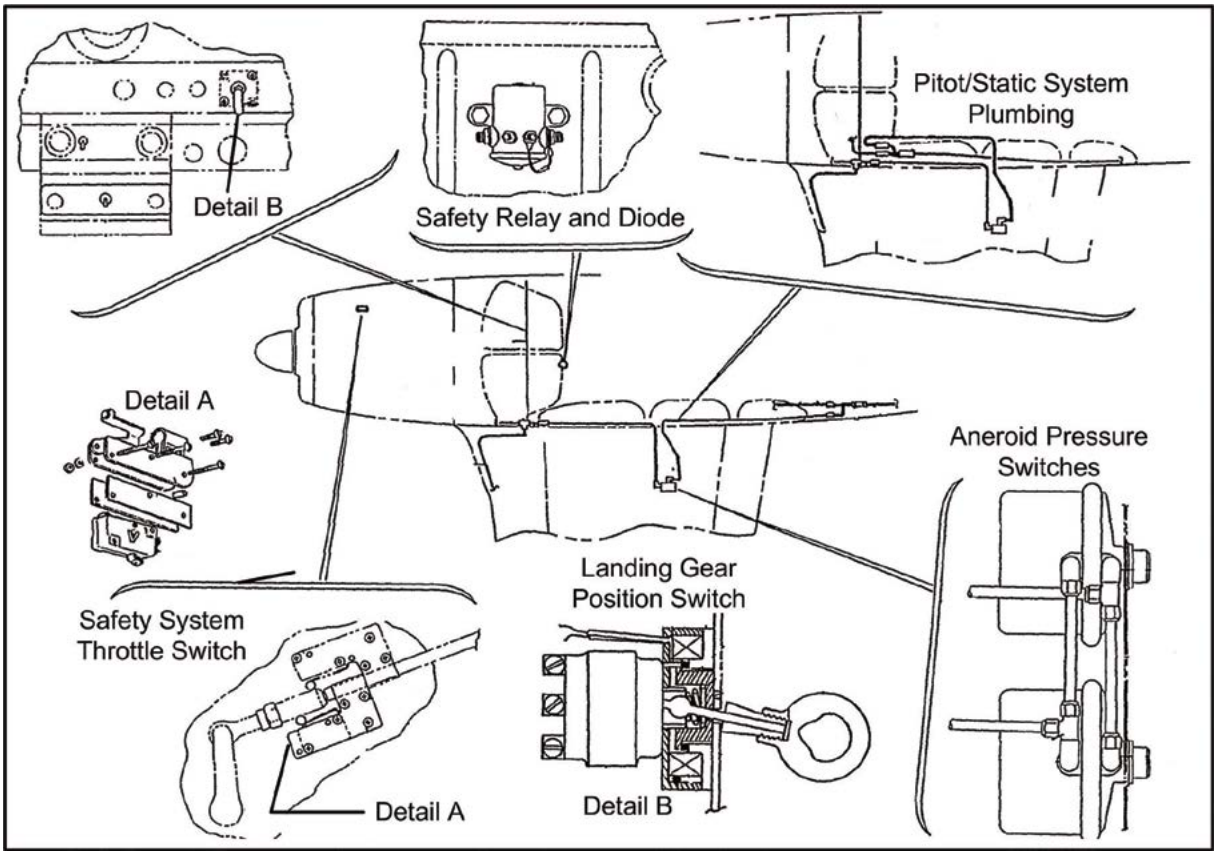

Figure 2: Safety system component location

It is located inboard of left landing gear wheel well and is connected into the pitot/static system. On twin-engine aircraft, this switch closes at 70 mph (61 kts) and higher.

- *120 mph (single- and twin-engine) pressure switch* — aneroid pressure switch in the gear-down electrical circuit that closes at airspeed of approximately 120 mph (104 kts) and lower. This switch is located next to the 90 mph pressure switch inboard of the left landing gear wheel well and is also connected into the pitot/static system.

Each of the two aneroid pressure switches is actuated by an internal rubber diaphragm. Static air pressure is on one side of the diaphragm while the pitot air pressure is on the other side. The pressure differential between the pitot and static air system changes as the aircraft's airspeed changes causing the diaphragm to deflect and actuate its electrical switch accordingly: open or closed.

Figure 2 shows the physical location of several of the system components in S35, C33, and later Bonanzas.

Preventing a Gear-up Landing

During takeoff, as the Bonanza or Debonair throttle is advanced to approximately 18 inches of manifold pressure, the safety system throttle switch opens. This action arms the safety system for automatic extension of the gear during the landing approach if necessary. On twin-engine aircraft, advancing each throttle to 17 inches or greater manifold pressure opens its respective safety system throttle switch.

In case the pilot fails to extend the landing gear on approach to landing with the safety system switch ON, the Magic Hand functions to "magically" extend the landing gear, thereby averting a gear-up landing. As the throttle on a Bonanza or Debonair is retarded to approximately 18 inches or less (or *both* throttles on a Travel Air or Baron are retarded to 17 inches or less), the associated safety system throttle switch closes. Then as the airplane slows to approximately 120 mph (104 kts), the 120 mph pressure switch closes completing the circuit from the landing gear position switch solenoid to ground. This causes the solenoid to energize and pull the pilot's landing gear switch to down—the gear extends in its normal operating sequence.

To summarize, the system will automatically extend the landing gear when:

- Bonanza/Debonair throttle is at 18 inches or less of manifold pressure or Travel Air/Baron throttles are both at 17 inches or less, and
- The aircraft airspeed is approximately 120 mph (104 kts) or lower.

Inhibiting Inadvertent Gear Retraction

With the safety system switch ON, the safety system prevents inadvertent or premature gear retraction. In a Bonanza or Debonair with the airspeed lower than approximately 90 mph (78 kts), should the pilot inadvertently attempt to retract the landing gear during the landing rollout or prematurely in the takeoff roll, the 90 mph pressure switch is open inhibiting actuation of the safety relay. With the safety relay inactive, its contacts are open so no power is available through the rest of the gear-up circuit to the gear motor. In a Travel Air or Baron the safety system inhibits gear retraction at less than approximately 70 mph (61 kts).

During a takeoff as airspeed exceeds 90 mph (78 kts) for singles or 70 mph (61 kts) for twins, the increasing pressure differential between the pitot and static air system closes the pressure switch. When the pilot selects gear up, the completed electrical circuit energizes the safety relay and routes power through the squat and up-limit switches to the gear motor—the motor runs to retract the landing gear.

Why and How the Safety System is Frequently Disabled

A recurring problem with the safety system is an air leak in either pressure switch, usually a failed diaphragm that compromises the airplane's complete pitot/static system. The result is, at best, a failed pitot/static system test or much worse—incorrect or no operation of the safety system along with possible incorrect flight instrument indications. The cost of a new switch, if available, is high.

The cockpit landing gear position switch also proved to be problematic with its complex mechanism that actuates the switch to its down position in flight. I understand that regardless of the switch's significant four-figure price…none are available.

Additionally, adjustment of a throttle-actuated microswitch is difficult and time consuming. The only way to determine correct adjustment is to test safety system operation in flight.

With recurring hardware and switch adjustment problems in addition to extremely expensive replacement components, some not available at any price, many owners had the system deactivated in their aircraft. In response to my query about removing or deactivating the system, ABS Senior Tech Advisor Bob Ripley wrote, "I have only seen a couple of aircraft with the system fully operational and still meeting the airspeed and throttle switch settings. To remove the complete system from the aircraft would be very time consuming and too costly. We normally install a *red* switch guard over the toggle switch in the cockpit, safety it down, and then bypass the pitot and static lines attached to the two switches in the left wheel well."

Epilogue

I was not able to find any information or even a pilot report regarding the landing gear safety system's success in averting a gear-up landing, preventing an inadvertent retraction during landing rollout, or inhibiting a premature gear retraction at takeoff. However, I'm reasonably sure there were events in the past where the "Magic Hand" fulfilled its intended purpose with the aircraft and its occupants arriving safely at their destination.