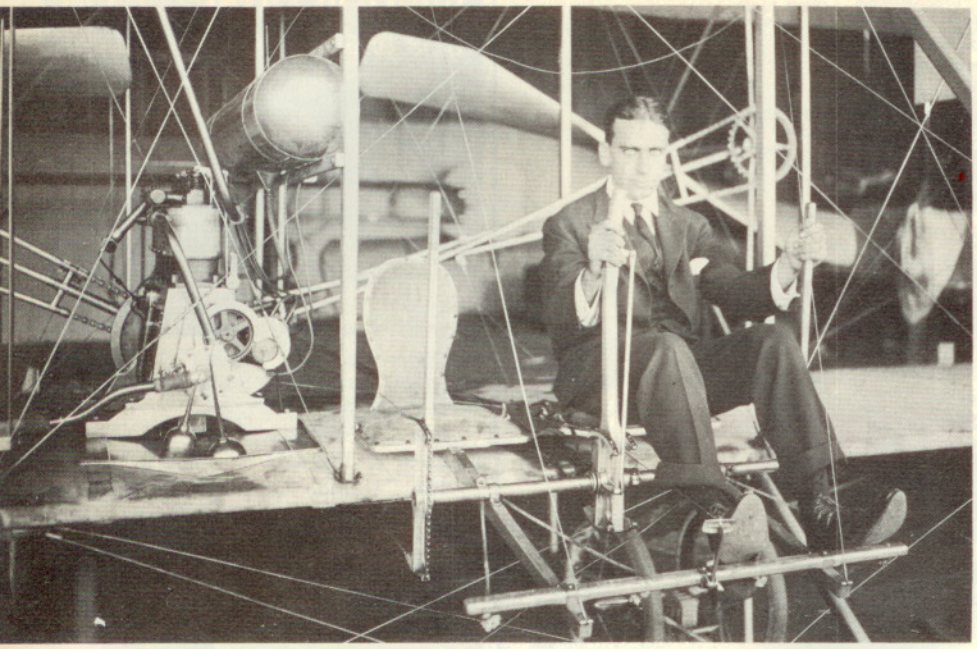
The controls of a Wright Model "B", circa 1911. The pilot's left hand is on the elevator control. His right is on the wing-warping control, which had a supplementary rudder control on the top and was shared with the right-seat pilot. The lever at the right side of the right seat is that pilot's own elevator control. Note the single foot pedal used by both pilots for spark control.



YESTERDAY'S WINGS

Confusing Control Systems

by PETER M. BOWERS / AOPA 54408

■■ How skillful are you at the controls of various airplanes? If you were trained in a wheel-control type, do you have trouble switching to a stick? If you learned in the left seat, how do you do in the right? Can you step out of a tricycle-gear model and handle a tail-dragger?

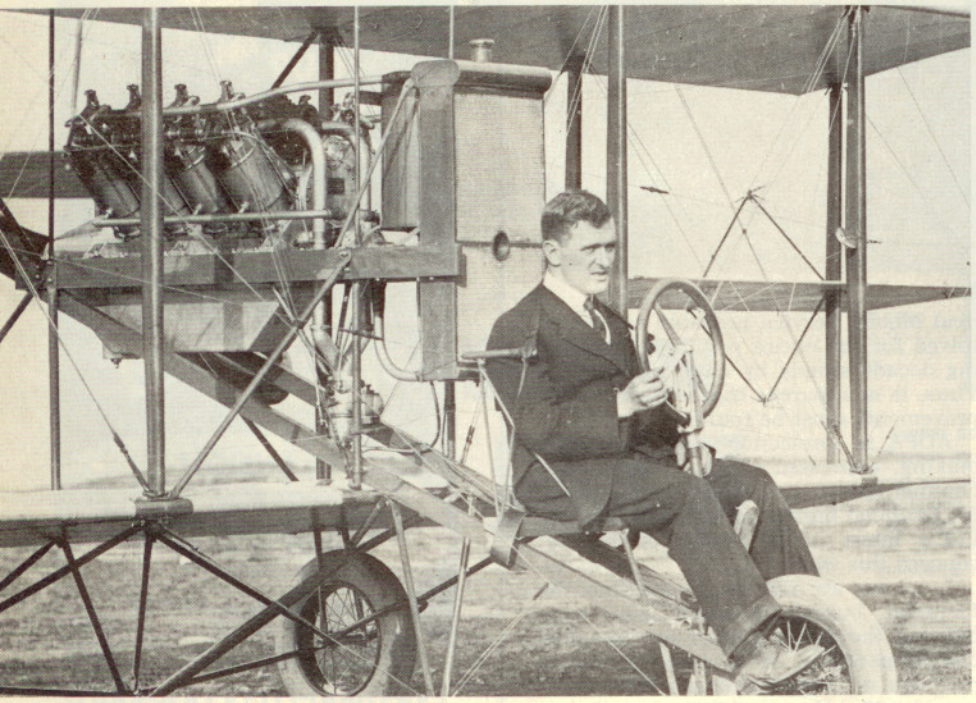
For most present-day pilots, these transitions are relatively minor—the differences aren't really as great as some people imagine. Actually, getting used to the different switch and instrument locations in different wheel-control models seems to be a bigger problem than the change from wheel to stick control.

It was not always so. Back in the pioneer days before World War I, the controls of airplanes were a long way from being standardized. Various manufacturers had their own systems, and the differences were so great that some pilots could not make the transition. There were actual cases in which pilots who were trained on one system had to have that same system installed in a plane they bought from another manufacturer that used a different one. A modern example would be a pilot who learned on a Champion insisting on stick control, heel brakes, and a left-hand, quadrant-type throttle when he ordered a Cessna 150.

Let's try a checkout on some of these early-day systems, and see what they were like.

First, of course, there was the Wright system. This was weird to start with. The pilot lay prone on the bottom wing and controlled pitch by rotating a horizontal rocking shaft that he held onto with both hands. Roll, which was tied into the rudder in a coordinated action, was accomplished by swinging the hips from side to side; the pilot's pelvis rested in a sideways-sliding cradle.

Later, when the Wrights sat upright, control was by means of upright hand levers. As the first to teach others to fly, the Wrights had the first dual-control airplanes. These controls, however, were not fully duplicated; nor were they symmetrical. The Wright biplanes were usually soloed from the left seat for balance purposes, since the engine was off-center to the right (see photo). This put the instructor in the right seat. The lever at his right worked the pitch controls, forward for "down" and backward for "up"—a natural action that we still use today. This control was duplicated at the left side of the left seat. Between the seats was a third lever, used by both pilots. This lever controlled roll, which still had the rudder tied in. Forward stick gave left roll; back stick, right roll—hardly a "natural" movement. If necessary, more rudder could be fed in by an auxiliary right-left lever on top of the center



The famous Lincoln Beachey at the controls of his special 1912 Curtiss stunter. The wheel works the rudder, fore-and-aft movement of the yoke works the elevators, and the brackets around Beachey's shoulders work the ailerons. The brake bar pressing against the nosewheel can be operated by the pilot's foot or by pushing full forward on the control column. A pedal under Beachey's left foot operates the spark or throttle for engine speed.

Chaos reigned—and crashes sometimes followed—when those magnificent men went from one early-day flying machine to another

What is probably the world's most unique aircraft control system put the ends of the control surfaces right in the pilot's hands! This is the Rheinhold Platz canard glider of 1923. The canard surfaces, worked independently, served both as elevators and as ailerons. With no vertical surfaces incorporated in this design, there was no need for rudder control.

stick. This system, which went through several minor variations over the years, resulted in recognized "right seat" and "left seat" Wright pilots—the transition from one seat to the other was not easy in those days.

The Curtiss system was considerably different and started with the pilot sitting up. By the time Curtiss was in production, his controls had been standardized with a wheel to control the rudder. Push-pull on the wheel controlled pitch just as it does today, but aileron control was by "body english." A yoke, pivoted behind the pilot's seat, bracketed his shoulders. To bank into a left turn, the pilot leaned to the left; to raise a low wing, he leaned to the high side. This is probably the direct result of Glenn Curtiss's having been a famous motorcycle racer before becoming a builder of airplanes. Curtiss retained this unique system on some models until 1915. Curtiss, incidentally, developed the "throwover" control column for side-by-side pilots in 1911.

A sort of mix between Wright and Curtiss control was introduced by Alberto Santos-Dumont in his 1908 "Demoiselle." The Paris-based Brazilian used two vertical levers for pitch and rudder control, and found, like Curtiss, that he had run out of hands. He remedied this situation with a special flying jacket that had a long tube sewed up the back. This tube fitted over a third stick behind the seat that controlled roll when the pilot leaned in the Curtiss manner.

The French "Antoinette" of 1909 substituted wheels at each side of the cockpit for the Wrights' levers. The left wheel controlled roll and the right controlled pitch. An innovation was the use of a foot bar to work the rudder. In addition, there were separate engine controls, which meant that the pilot had to let go of one of the other controls in order to manage the powerplant. The Wrights and Curtiss didn't have that problem at the time; both used a foot lever to control spark—the only speed control on the engine.

The Wrights and Santos-Dumont used wing-warping for lateral control, while Curtiss used ailerons. The designer of the "Antoinette" tried everything at various times, first warping the wing, then pivoting each entire panel at the fuselage before standardizing on ailerons.

The first of the standardized control systems we use today was the stick-and-rudder-bar arrangement, developed by a Frenchman, Robert Esnault-Peltrie, who gave us a single stick to control pitch by fore-and-aft movement and roll by sideways movement. Rudder control was by the foot bar, as on the "Antoinette." (The bar soon had an alternate installation in the form of pedals, which are universal today.) This control system came to be called the R.E.P. system.

While the stick control seemed a fairly "natural" procedure for movement about the pitch and roll axes, the rudder control was definitely not a natural. Anyone who ever used a home-built coaster wagon or sled with the steering controlled by the feet finds it natural to push on the *outside* of the turn. It is the same way with the bicycle or motorcycle—the push is on the outside. The foot-operated rudder control calls for the push to be on the *inside* of the turn. This gave many early-day pilots trouble, and some actually reversed the rudder cables on their personal planes. Some fatal accidents occurred when these pilots stepped into other planes and forgot the standard procedure, or when other pilots used the modified aircraft.

A relatively minor variation of the R.E.P. system was developed by another French manufacturer, Deperdussin. This used the R.E.P. rudder control, but had a wheel on a yoke instead of a stick. Fore-and-aft movement of the whole assembly still worked the pitch control, but rotation of the wheel moved the ailerons (or warped the wings; wing-warping was fairly common as late as 1916 and Guiseppe Bellanca used it on a production lightplane in 1919). After the R.E.P. stick control became the accepted standard, wheel control was distinguished by being referred to as the "Dep" system.

Standardization was still a long way off. In one of his attempts to beat the Wright patents, Curtiss tried one system, in 1914, in which only one aileron was operated at a time, and that by a foot pedal. William E. Boeing came up with something else on his first airplane, built in 1916. His system had a patented "three-way" control with a wheel on top of the stick to work the rudder, sideways motion of the stick for the ailerons, and fore-and-aft motion for the elevators. The throttle was a foot pedal, similar to that in a car. This system was soon changed to the "Dep." (The replica that Boeing built for its 50th anniversary in 1966 uses stick-and-rudder.)

Perhaps the most unconventional, yet direct, control system of all time was that used on the Rheinhold Platz canard glider of 1923. To appreciate the control system, one has to understand the design of this unique machine.

This was an early ancestor of the present-day "Rogallo Wing," in which the wing surface is a single thickness of cloth. In planform, the Platz glider looked like a small sailboat mated to its waterline mirror image. Like a sailboat pointed upwind, the airfoil was maintained by the flow of air over the sail-like cloth wings. The "mast" was a 24-foot spar, held in a curve by a cable (as on the bow of a kite) that formed the leading edge of the main lifting surface.

The canard surfaces were essentially like sailboat jibs, with their "booms" pivoted on the fuselage near their forward ends. In addition to contributing to the total lift, the jibs also served as the control surfaces. There was no rudder.

For control, the pilot held the free ends of the booms in his hands, which meant that he was also holding some 10% to 15% of the total lift in position with his own muscles. (These surfaces do not "trail" with zero stick force as do conventional elevators and ailerons.) To lower the glider's nose, the pilot raised both hands evenly to decrease the jibs' angle of attack; to raise the nose, he pulled down equally with both hands. For roll to the left, he raised his left hand and pulled down with his right. To raise a low wing, he pulled down on the low side and pushed up on the high side.

Now, did you say you had a problem in changing from a wheel to a stick? □