The Spotlight on McCook Field

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Foreword—This article is written for the sole purpose of broadening the reader's point of view concerning the Official Testing Field and Airplane Experimental Engineering Division of the U. S. Air Service. It will not, however, present any facts of a technical nature which are held secret by the War Department until released by the Technical Data Section of the above division.

Geographical Outline—The testing and experimental work of the Official Testing Field and Airplane Experimental Engineering Division of the U. S. Air Service is conducted at present on McCook Field, a one hundred acre tract of land within the city limits of Dayton, Ohio. This field is in many respects well equipped. It has an adequate motored fire department, a unit heating plant, a hospital, a service garage, a cafeteria and its own water supply. The finished raw stock rooms occupy three buildings which cover approximately 15,000 square feet of ground area. Three hangars are used for storing planes and for minor repair work. Approximately sixty men are employed in the hangars and in ground work on the field for the purpose of getting the planes ready for flight. In the main assembly building about forty men are employed. Here all plane assembling, wing covering, doping and sand test work is done. The main building accommodates the pass, employment and executive offices, the machine and wood shops and the inspection department on the first floor; the engineering drafting on the second; and the structural and aerodynamic branch on the third floor. The shops employ approximately 350 men; the production and experimental drawing, specifications, standards and records branches, 170 men and women.

Experimental Plane Design—On experimental plane design, there are three groups now active. Each group works under the supervision of an aeronautical engineer who is held responsible for the work turned out by his group. This division of the Air Service develops planes for military purposes only, except the most recent product, a racer. This racer will be described later. Military planes are classified by types. These types are determined by the inherent characteristics of the construction and equipment of the planes. The main types are: one and two place pursuit planes or fighters; transport; freight and messenger planes; day and night bombers; ground attack (usually armored); observation; scout or reconnoissance and training planes. The one or two place pursuit planes or fighters carry one or two fixed machine guns, synchronized with propeller, or shooting through the hub of the propeller on the geared motor. The guns now in use are the 30 caliber Browning, 50 caliber Browning, 30 caliber Vicker and Marlin. On the two place fighters, the Lewis machine gun on a flexible mount is used. The observation, scout and reconnoissance planes carry cameras and radio equipment.

New Models Are Developed—No new model is started without an official order. This order specifies the type, requirements in performance, as to cruising radius, ceiling, etc.; armament; radio or camera equipment; and motor to be used. The choice of motor may be left to the decision of the designer, at least it is not specified, until the power required has been calculated. The engineer in charge works out the preliminary design and outlines it with sketches before his layout men who may suggest the details of construction and upon the approval of the designing engineer develop them. The structural and aerodynamic branch or research branch cooperate with the designer and check up or give plane settings, balance of ship, make stress analysis of fuselage, landing gear, wings and external bracing. After the layouts are completed and O. K.'d, the individual parts are detailed on vellum paper so blue prints can be made immediately. Ink tracings are made after the plane has passed its final experimental stages and is ordered for production.

Practically every new model plane requires a special design of radiator shell. This is often necessary to get a good streamline, if it is a nose radiator, or to suit the mounting when the radiator is supported as an individual unit. The cooling system branch cooperates with the designing engineer of the plane in working out the thermodynamic problems.

The standards branch collect data from catalogs, handbooks and shop experience and issue standard sheets which list small parts as bolts and pipe fittings, by sizes and numbers. They also issue instruction sheets which are used as guides by the draftsmen and checkers. All details are drawn up to conform to these standards.

The specification branch draws up specifications which include the composition and physical properties for each material that is used in aircraft construction. Copies of these specifications are available in the drafting room. These are referred to and material is specified on the drawings by name and number. The number refers to the specification sheet.

After the details are drawn up, they are checked for standards, shop practice, material, aeronautical design, completeness of information, and with the layouts and main assemblies, for accuracy of dimensions, fits and interferences. As soon as the approval of the designer and chief draftsman has been received, prints are made and distributed and an order for stock issued to the proper section of the shop by the planning department. When each part is completed, it is sent to the inspection department where it receives a rigid inspection. If it passes inspection, it is sent to the proper stock room where it is stored until it is drawn out for assembling. As it is necessary for each part entering into the construction of an airplane to be infallible in its functioning, accuracy of workmanship must be an ideal of the workman making aircraft parts.

Plane Testing—Before completely assembling an experimental plane for a flying test, a sand test, run under the supervision of the research bureau, is made of the fuselage, wings, control surfaces, and controls. The factor of safety is calculated after the recording of the breaking load in the sand test. For the factor of safety, certain standard requirements must be fulfilled, such as 7 for wings.

Tests are not restricted to government planes alone. Any private corporation can have official tests made by submitting two machines, one without motor for the sand test; another complete for the flight test. Of course, all machines must successfully pass the sand test before a flight test with that model is attempted.

Propellers—The propeller branch of the design section has developed a reversible pitch propeller. The results of tests of this propeller have been very satisfactory. It is not permissible at this time to publish the details of its construction. But this feature may be a part of the airplane as the transmission is a part of the automobile.

Endurance and efficiency tests have been run on a Bakalite Micarta propeller built by the Westinghouse Electric and Manufacturing Company. These tests showed remarkable results. One of these propellers withstood over 1300 h. p. This was all the power that the dynamometer would supply. This propeller was run at a speed of 2100 r. p. m. Its efficiency was also very good, because of the thin blades which are permissible with this type of construction and material. These propellers are made with a special fabric impregnated with Bakalite, reinforced with piano wire, pressed into dies under enormous pressures with hydraulic presses.

The propeller test rig is one of the most adequate in the country. This testing is done in the open. The propeller to be tested is securely bolted to a hub on a shaft driven by electric motors which are capable of supplying over 1300 h. p. The degree of danger that is associated with propeller testing is greatly decreased by surrounding the spinning propeller with a massive guard of timber.

Motors — The Experimental Motor Design Branch at McCook Field has been doing its share in giving contributions to the aircraft industry. It will soon have on test an 18 cylinder "W" engine, which will excel all present engines in power and simplicity of construction. This branch has already developed a syphon gasoline pump and the Angle gas engine indicator.

One of the latest productions is the single cylinder "Universal" Test Engine. The basic parts of this engine are flexible for various combinations. A unique feature of the crank shaft permits of adjusting the stroke within a range of about two inches. Two sizes of flywheels can be used. It has a universal magneto mount and attachments for an over or side camshaft.

The compression ratio can be varied by raising or lowering the piston by means of shims. The latest design for a test cylinder is one with a variable valve lift which can be operated while engine is running.

Before any motor is installed in a plane, it is given a thorough dynamometer test. During this test the necessary adjustments are made. This testing is necessary for at least two reasons: (1) the dynamometer room is by far a better place for such work than the field; (2) some installations are so built up that parts of the motor are inaccessible. This laboratory is equipped with Sprague dynamometers, and is considered the best in the country. Practically every make of engine, for aviation duty, both American and foreign, has been tested in this laboratory. Some of the best known makes are: Liberty 12 and 6 cylinder, Hispano Suiza 300 h. p., Packard big 12 cylinder, Hall Scott 6 cylinder, Kirkman 12 cylinder, OX-5 and V-2, both 8 cylinder engines; King Bugatti, Fiat 700 h. p., and Mercedes. Of the air-cooled type are these: the A. B. C. and Lawrence, radial; the Gnome and Le Rehone, rotary.

The Racer—One of the most recent products of McCook Field is the V. C. P.-R., the army air service entry in the Gordon Bennett international airplane race of 1920. The holder of the world's altitude, Major R. W. Schroeder, was to pilot this plane. It was designed by Mr. A. V. Verville, first as a "Chasse" plane and carried the Hispano Suiza 300 h. p. motor. It was redesigned for the racer by making many refinements and by adding an extension to the front end of the fuselage. This additional length of the engine bed was necessary to accommodate the new Packard big 12 engine. This engine delivers 578 h. p. with the low compression pistons and 638 h. p. with the high compression pistons at 2000 r. p. m. It weighs a trifle over 1100 lbs. It is Delco equipped, and has dual ignition and valves. Lubrication is by dry sump system, with one pressure geared pump and two scavenging pumps. The radiator which is carried under the fuselage, is of the honeycomb deep core type. The motor controls are: (1) the throttle, (2) the spark, and (3) the altitude. The fuel supply will last, with full throttle, 1 hour and 15 minutes.

In order to get maximum speed from a plane, all resistance must be reduced to a minimum. For this reason all parts in the slipstream, in the path of the wind, are streamlined. At high speeds enormous pressures are encountered with on frontal areas. At a speed of 200 miles per hour, frontal resistance is equal to 105 pounds per square foot. On the V. C. P.-R. streamlining was carried out to a high degree of precision, from the spinner on the propeller hub to the trailing edge of the rudder.

The fuselage was of the prisciform monocoque type, which is built up of from three to five layers of plywood strips laid diagonally and glued together. This construction permits of good streamlining. The exhaust headers were covered with an aluminum streamline. All angles, such as occur where landing gear struts and tail plane intersect the fuselage, are carefully carried out with a filler of balsa wood.

Balsa wood is truly an aircraft material for some purposes such as filler blocks. This wood works and looks similar to very soft spruce. Its specific gravity is lower than that of cork. The tree belongs to the conifer class.

All external wiring of this racer has streamline section.

The top wing with a span of 27.5 ft. is built in one section. Within the central portion, between the spars, there is built an auxiliary gravity, gasoline and water supply tank. The chord decreases from 72 inches at the center to 42 inches at the ends. The taper of the leading and trailing edge is symmetrical about a lateral centerline. The lower wing with a span of 26 ft. has a variable chord like the top wing and carries the balanced ailerons. The ailerons are controlled by the rigid or positive system which consists of a torque tube through the wings and bar links and rocker arms between the torque tube and the control stick. The total wing area is about 230 sq. ft. The vertical fin is built in as part of the fuselage, while the horizontal stabilizer is detachable.

This racer did not enter the Gordon Bennett race. Sufficient testing had not been on the motor, before it was sent across, to get it in proper adjustment.

Other Planes—A few of the other interesting models that have been produced at this field within the past year or so are: an armored battleplane, a three passenger ambulance plane, a large ground attack tri-plane carrying a number of Lewis machine guns and the new 37 m/m cannon, and the X. B.-1, which is a unique plane on account of its equipment and refinement of details in construction.

Armament—The Armament Section of the Ordnance Department is also located at McCook Field. This section conducts all gun and bomb tests and develops armament equipment. It has been instrumental in the development of a number of improvements on the standard makes of guns now in use, and for the Marlin Trigger Motor, Nelson Synchronizing Gear, the 37 m/m aviation cannon and the 50 caliber Browning machine gun.

The gun range is located in the north end of the field. Here the machine guns and the bomb equipment are tested. An interesting test was made to determine the relative effective value of bombs versus the 37 m/m cannon, when used to attack tanks at low altitudes. The 37 m/m cannon was mounted on the nose of a Martin Bomber. Firing was done at an altitude of 100 feet and at a speed of 120 miles per hour, conditions which made target practice not at all easy. Three hits were made out of five shots.

For testing the bombs, a D. H.-4 was loaded with eight fragmentation bombs. Two were dropped singly to get the range. On the second circle of the field the remaining six were dropped in salvo. Two made direct hits, the remaining four cleared the top of the target by three or five feet and struck ground less than 30 feet beyond the target. If the target had been an actual tank, all six would have registered direct hits. These results are remarkable considering the low altitude and high ground speed.

Structural and Aerodynamical Branch—In addition to working stress analysis and determining factors of safety from sand test results, the Structural and Aerodynamical Branch, better known as the Research Branch, has worked up a set of charts from which the sizes of columns can be easily read, whether the material be wood, steel or dur-aluminum. It has also worked out the Kerber design and performance charts for airplanes; with which charts the complete performance of an airplane can be predicted within one or two per cent error.

All wind tunnel tests are run under the supervision of this branch.

Parachutes—Within the past year and a half numerous tests have been made on parachute jumping Weighted dummies are used to make all preliminary tests. By the results of these tests, a number of the obstacles that entered in parachute construction have been discovered and eliminated. And now there are parachutes that can be depended upon. They will stimulate experimental testing and make pleasure flying more enjoyable.

Analytical Laboratories—The metallurgical and chemical sections have been busy experimenting with a variety of secret combinations of metal alloys and heat treatments which will make a real aircraft building material. This material should have these positive qualities: light weight, non-corrosive, high tensile strength, resistance to bending, but ductile and homogeneous throughout.

Camouflage—After the material has been collected and all construction work done, the ship is not finished until it receives a coat of paint. Paint is essential to a plane for at least three reasons: (1) to protect it against the weather, (2) to guard it against fire, and (3) to make it appeal to or to screen it from the eye. Wings are coated with three or four coats of dope which is an acetate solution and two or three coats of varnish. A dope of nitrate solution makes the smoothest surface, but that solution is inflammable, while the acetate is not. The artists at McCook Field are able to render any effect desired on a plane. Indeed, they prove that believing is not always by seeing.

The Slipstream—For the welfare of every organization there must be some means of appealing to the aesthetic desires of its members. Something to create and hold their mutual cooperation. At McCook Field *The Slipstream,* a semi-monthly magazine, is edited and published by the employees. H. A. Sullivan is editor-in-chief. A number of the employees from the engineering department, as well as from other sections of the field, contribute to each issue, a few lines of news, good cheer, praise, comment or light entertainment.

McCook Field has no Stadium, but the employees are organizing interdepartmental athletic teams,