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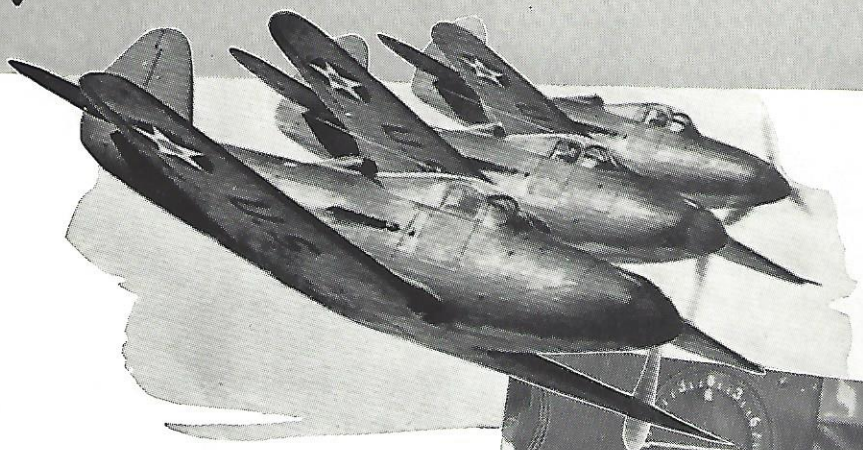

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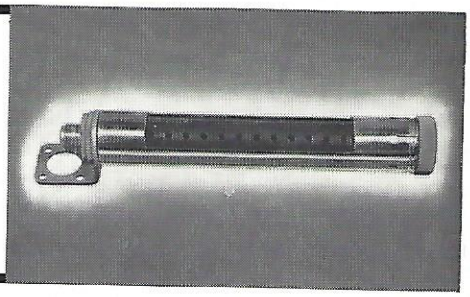

ELECTRONIC LABORATORIES, INC.

LIGHTING DIVISION, INDIANAPOLIS, INDIANA

FIRE POWER OF THE AIRACOBRA

By PERCY T. COLE, Associate Editor

High over Britain and France these days the first of a mighty fleet of fighting aircraft from Buffalo are going through their paces under the delighted hands of Royal Air Force pilots. Their ships are the Bell Aircobra—the machine fighter that pilots are calling "cannon on wings".

Nobody has ever said that Royal Air Force pilots were not satisfied with the fire-power of the deadly Spitfire, whose eight chattering machine guns have "done in" so many Germans. But nobody, either, would object to having a cannon in the Spitfire, as well as the machine guns. Due to design, it wasn't possible to fit a cannon onto the Spitfire's nose. That's where the Airacobra has his.

Fire-power is a matter of life and death importance in a pursuit ship, and the need for an explosive shell—a cannon—has become increasingly important. Bell engineers went to work on the problem.

"Cannon on Wings"

Since 1935, when the Airacuda, Bell's first fighter ship was conceived, a "cannon on wings" has been the ultimate goal. The Airacuda had two cannon, since it was a twin-engined fighter of the pusher type, with the guns being mounted where the engines of the ordinary plane are usually mounted.

The idea has been carried over to the production model of the Airacobra, a single engined fighter. The engine is located behind the pilot's seat, with a long drive shaft running forward to a gear box in the plane's nose. The gear box arrangement results in two things—plenty of room for installation of the cannon, which fires through the propeller hub, without interfering in any way with the operation of the three-bladed propeller.

On the export version of the Airacobra, the cannon installed is 20-millimetre type. For the U.S. Army Air Corps, a 37-millimetre cannon is used. In addition to the cannon, two .50 calibre machine guns and two .30 calibre machine guns are installed in the wings. With all guns blazing, the Airacobra truly is a winged projectile!

Cannon Proven in Tests

Bell test pilots have shown the skeptics in actual firing demonstrations along the shore of Lake Erie that the cannon is a highly-effective weapon. The firing tests made by the company were not to test for accuracy in hitting the target, but merely to test the effect of firing on the guns the plane carried and on the plane itself. Yet over 40 big wooden floating targets were demolished, blown out of the water, as the test pilots swooped down at them from heights of over a mile and at speeds of well in excess of 400 miles per hour.

Watching the pattern of shots as they struck in the blue water, one could readily realize the utter havoc which could be created on a mechanized column moving along a road. Bell engineers say the 37-millimetre cannon would take care of a tank—not destroy it, but disable it, which is just as good for blitzkreig purposes—and the cannon would certainly bring ruin to any mechanized supporting column less heavily armed than a tank column.

Bombs can be dropped on these columns, and effectively, but the cannon is much more accurate, and can be used from far greater heights, with corresponding greater safety to pilot and plane.

This close-up of an Airacobra's nose shows the muzzle size of the powerful 37 mm. cannon which fires through the propeller shaft.

Equipped with

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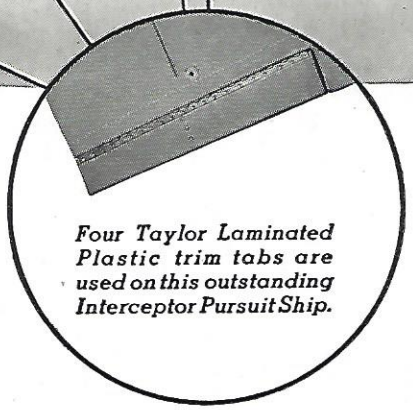

Four Taylor Laminated Plastic trim tabs are used on this outstanding Interceptor Pursuit Ship.

A new technique in the fabrication of vital aircraft parts from laminated plastics has made possible increased strength and durability with lighter weight in such important parts as trim tabs, wing flaps, radio antennae masts, etc.

These parts are mass-produced in seamless, one-piece phenol fabric construction. Their strength and resilience are due to the inherent characteristics of the material itself and to the structural form of the part.

There is no permanent distortion under deflection. Fine surface finish is characteristic of the material. Projectiles pass through cleanly, have less tendency to tear or collapse the structure of the part.

These and other reasons are why Aircraft manufacturers are finding Taylor Laminated Plastic construction "generally more satisfactory than metal" for a growing number of parts.

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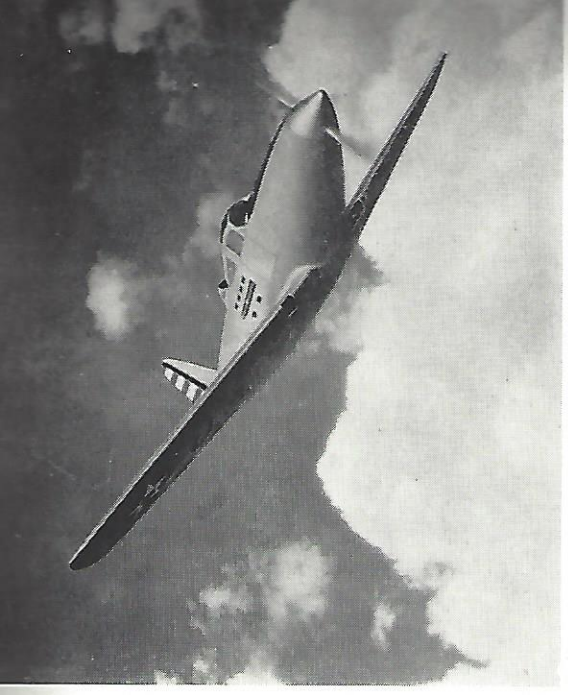


Flight Testing The Airacobra

By F. R. WALKER
"Commercial Aviation"

Airacobras, completed at Bell Aircraft Corporation's new Niagara Falls assembly plant for fly away delivery to the United States Army Air Corps, are given a comprehensive test flight, together with 90 minutes of "slow time" flying, before being turned over to Air Corps pilots to be ferried to an army field. Airacobras for Britain's Royal Air Force built at the company's Buffalo plant are also tested but only one out of 20 is flown here; the others are crated and shipped without flying. Test flying for most of the British 'Cobras, is done across.

The actual business of flight testing is preceded by a careful ground inspection, after which the 90-minute "slow time" period is logged to determine that the Airacobra is performing satisfactorily before cross country delivery flying begins. This is a far cry from the business of top speed, three-mile vertical dive and other gruelling performance manoeuvres ordinarily envisioned by the phrase, test flying Rather, the test program followed at Bell Aircraft is an all-around inspection, on the ground and in the air, to make sure that the new fighter plane is all it is supposed to be.

More than three score items must be noted on a carefully thought-out form, before the Airacobra is turned over to government authorities for acceptance. Following is a step-by-step account of the work done, the only omissions being those items restricted by government regulations.

Exhaustive Pre-Flight Tests

The ground test begins when the pilot enters the cabin. First he checks the doors—one on each side—to make sure the latches mesh properly. Next, he turns on the main ignition switch to see that the many electrical instruments are functioning properly. With a mechanic at the wingtip, the pilot continues his test, checking navigation and other lights and travel of the prestone cooling system's shutters. These shutters are located on the plane's belly, and can be opened to varying positions to permit an outflow of air which has passed through the cooling system. This air enters through vents in the leading edge of the wing near the fuselage. At this point in the test procedure, the pilot sets his parking brake, remembering that upon examination several minutes later, the brake must be holding fast. The importance of these preliminary checks is obvious. All equipment must function perfectly for safety in high speed flight.

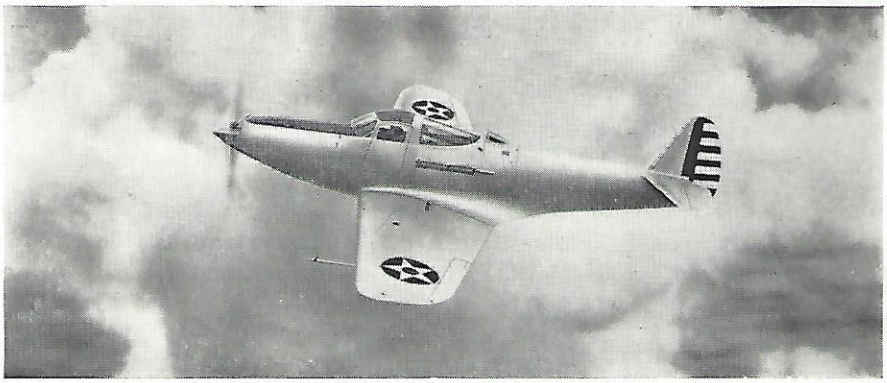
At this point, the pilot observes the direction, extent of travel and neutral position of ailerons, rudder, elevator and restrictive trim tabs, using his stick to ascertain this information. Once the 1150 h.p. Allison has begun to tick over, the pilot notes the functioning of the wobble pump, previously having observed the operation of the electric starter. As soon as the motor has warmed sufficiently for power to be drawn, the throttle is opened to give at least 2,000 r.p.m. Any drop in revolutions when only one magneto is in use is noted.

Manifold pressure in inches of mercury is tabulated, and as the propeller pitch setting is changed, the pilot watches the tachometer. Switching to manual control, he next adjusts propeller pitch by hand, after which he returns to automatic low pitch and prepares for the takeoff. Flaps are run up and down; the indicator is checked, and the pilot checks the foot brakes by taxiing.

Flying Tests

Ready for the takeoff, the pilot makes sure his Allison is on emergency rich, reserve tank, and checks his tachometer and gyroscopic instruments. As he roars down the runway, the pilot continues his observations, making sure that the throttle stop prevents more than the specified inches of manifold pressure, and that the r.p.m.'s don't exceed army specifications.

Once in the air, the pilot climbs at a prescribed manifold pressure and r.p.m., constantly noting the engine temperature instruments. Trimming for level flight—the third portion of the inspection—he throttles back. At this point, the Airacobra is operating on automatic lean mixture, with wheels retracted and shutters flush. After five minutes, altitude, airspeed, free air temperature, prestone and oil temperature, oil pressure, gear box pressure, fuel pressure and the charging rate are all listed on the card. The throttle is cut to determine whether the landing gear horn and its silencer are functioning properly—the horn sounds



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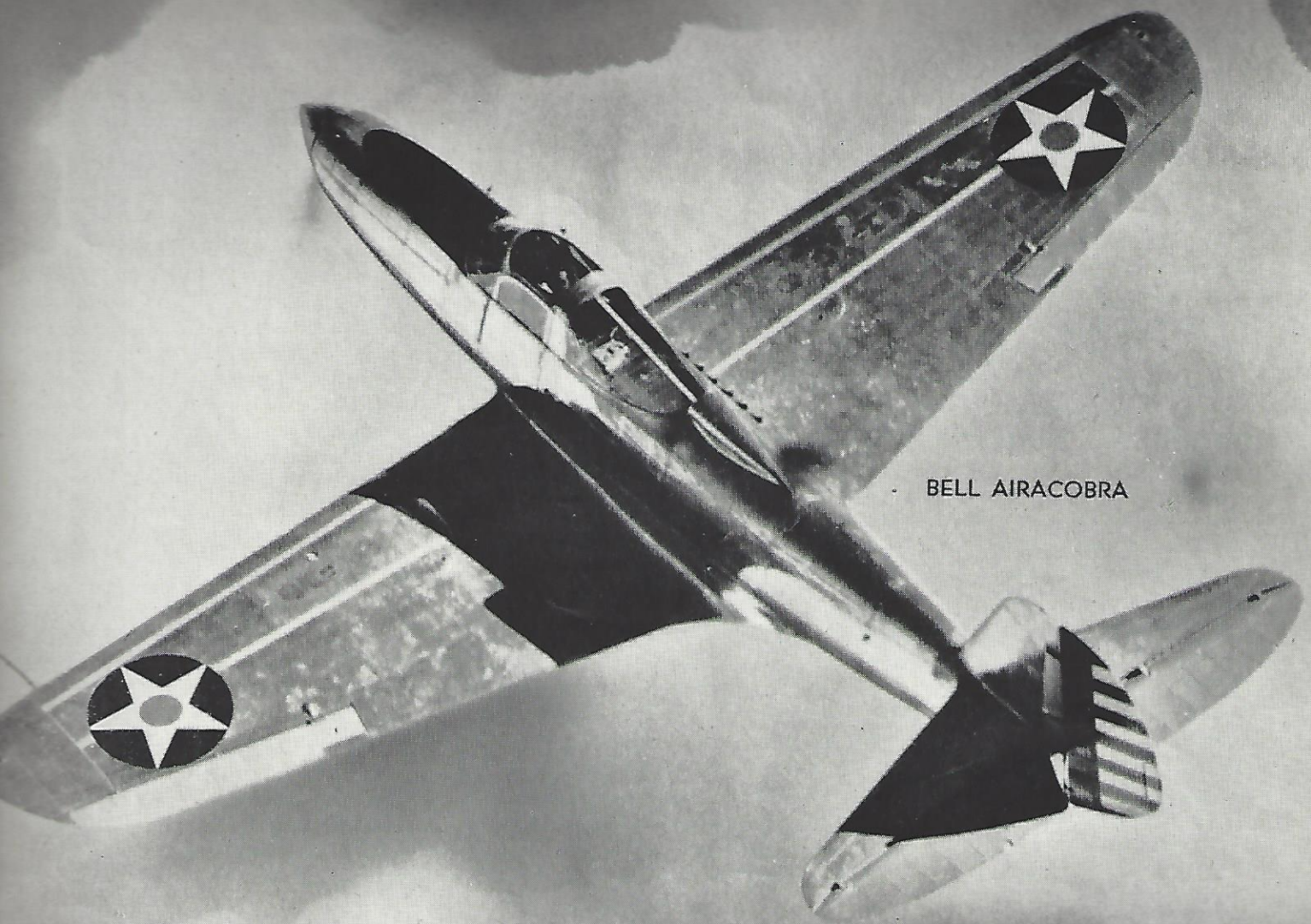

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CONVEYORS

(*Concluded from page 20*)

manager, came forward with the suggestion that a mechanical dipping system be set up. We consequently conferred with Richards, Wilcox Company of Aurora, Illinois, about the possibility of adapting types of equipment they manufactured to our purposes.

The result, following closely a design by our own Robert Distin, was an endless chain system, 400 feet long. (George Carson, one of my assistants, did splendid work during the manufacture and installation of the unit). At one end were platforms from which workmen reached up to attach small parts to hooks on the conveyor. In the case of tiny parts which needed painting, a Christmas-tree arrangement was used, on which a score or more small parts could be hung, after which the entire "tree" was attached to the conveyor.

Moving slowly, the conveyor carries the parts to a dip tank 20 feet long, three feet deep and 18 inches wide. The first tank holds chrome yellow paint, which is kept in proper solution by a mechanical agitator. The parts then are lifted out of the dip tank, and pass by infra red heat lamps, which dry from the metal outward, and steam radiator units. The line then carries the parts into the second dip tank, and again past lamp and radiator drying units. No fewer than 1800 pieces an hour—not counting the "Christmas trees" may be dipped each hour by this constant motion method which cost little more than $3000 to install.

An investment of about $16,000 is involved in the installation of the four drag chain conveyors, recessed into the floor of the Niagara Falls assembly plant. These conveyors were made by Mechanical Handling Systems, Inc. of Detroit, and provide constant motion to the final assembly lines. Electric motors, geared down, keep the chains moving. Dollies, cradling forward fuselages, are rolled to one of the assembly lines, and then are hooked on to the chain, which slides along a channel sunk into the concrete flooring. Forward motion, at the rate of ⅜ inch a minute, is so slow as to be barely perceptible to the observer, but the dollies move from station to station like clockwork and assembly work is carried out with similar precision and constant speed. At our Buffalo plant, we also use the straight line assembly system, but fuselage dollies are pushed from station to station by hand, at scheduled times.

Among our own people, the constantly moving assembly line has been considered a complete success, from the day in mid-June when it first began to operate. As production schedules are advanced, the two lines now idle will begin to move, and it seems very probable that two additional lines, making a total of six, will be installed in the not too distant future.

Our third system, also manufactured by Mechanical Handling Systems, Inc., will extend 5000 feet around our Buffalo plant, servicing no fewer than 24 stations. A total of 170 metal baskets, capable of carrying 100 pounds of material, will be used on this conveyor, which will move at the rate of 40 feet a minute, and will be powered by a 5 h.p. electric geared motor.

At the time of writing, this system is nearly complete, and we are eagerly awaiting the first days of test. Electrical controls provide for easy control of shipments, and the prospects are for a considerable speeding up of the business of stock chasing, and proper routing of small parts by this mile-long mechanical messenger boy!

How far the aviation industry will go by way of introducing more methods of mechanical delivery of parts depends largely, as I see it, upon the amount of airplanes which are going to be needed to knock out the aggressors. If production rates continue to increase, then, almost certainly, more mechanization may be expected.

A corner of the machine shop in Bell's Buffalo plant. Latest of machine tools are employed to cut every production "corner" possible in the race to step-up output.

BELL PLANT PRODUCTION

(*Continued from page 10*)

other alternative would be to build it in cramped quarters of the main assembly jig as was done on the Airacuda.

Because of lofting, all parts are interchangeable and thus stocks of decks, bulkheads and skin sections can be built and stored making possible a smooth flowing production line. Any change that occurs is made through the lofting department who are in a better position to plan out how the change can be accomplished successfully on parts already built eliminating scrap and through changing the templates make the change effective immediately on subsequent parts.

With bulkheads and parts on hand, the mechanic merely lays the deck section on a pair of horses and with Clico fastener pins the bulkheads in position, drills, and rivets them. Since the co-ordinated lofting holes eliminate blueprints from the shop, all the training that is required of a man is the ability to use a drill, drive, and buck up rivets.

Having fastened the bulkheads, he pins the sections of skin in place. As will be noted, the rivet guide holes are already

(*Concluded on page 28*)

ALUMINUM IN AIRCRAFT

A knowledge of aircraft aluminum, its composition, peculiarities, and working qualities, is of importance to any aircraft plant worker who aspires to promotion in his trade. In these days of excellent institutional advertising, which is often more educational than high-pressure, an excellent supplement is provided to the regular textbooks. "Aluminum in Aircraft", a recent publication of the Aluminum Company of America, is an attractive 104-page, wire-bound booklet, of definite educational worth. Attractively presented, with numerous illustrations in the form of photos showing dural aircraft parts and the machinery used to cut, form and fabricate them.

BELL PLANT PRODUCTION

(*Concluded from page 26*)

drilled. No individual planning and spacing is necessary which eliminates missed rivets or the possibility of drilling the holes so that they run out of line and don't go through the rib.

Fuselage Eight Hours on Jig

Up to this point, it will be recalled that only one jig has been required in building the main assembly. In order to position within the extreme tolerances the attachment points for the stabilizer and rudder hinge as well as drill the fuselage attachment point holes, the assembly is inserted in the jig illustrated. The drill jigs utilized for drilling these holes, however, are co-ordinated with the master template so they are actually lofted. Working conditions around this jig present a striking comparison to the assembly fixture for the Airacuda. Realizing that the structure was practically in its complete state before insertion, it is easy to understand that the jig is only tied up for eight hours per fuselage instead of weeks when ordinary production methods are used.

With this comparison, it is easy to see how co-ordinated lofting saves hundreds of thousands of dollars of expensive tools and jigs which are just scrap when the design changes. Increasing production becomes a matter of adding men and assembly benches rather than huge fixtures and acres of floor space. Further the major portion of these workers need only be trained in the rudiments of aircraft factory practice. Thus in developing this lofting for production technique, the Bell Aircraft Corporation feels that it has made a contribution which will help the United States and Britain immeasurably in building their air strength quickly and efficiently.

AIRACOBRA FLIGHT TESTING

(*Concluded from page 24*)

when the throttle is cut, as during landing approaches, if the wheels are not down.

Once he has determined that all trim tabs are functioning properly, the pilot flys hands off, while he fills out more blanks. Besides performing all the clerical chores listed above, he has still to observe the operation of the fuel selector valve, check his stalling speed with flaps up and down, and watch the performance of his cabin heater. When temperature drops to 60 degrees below zero and lower, as is the case during altitude flights, this latter is of vital importance. Gyro instruments are checked, while alternate suction source is used, and again during main suction, when the venturi is retraced. Landing gear is tested, with the pilot paying special attention to the wheel position indicator, and to the pop-ups which serve as double check instruments to show wheel positions. Landing gear is also extended manually.

Ready for landing, the pilot has become familiar with his new Airacobra, and flies in to a competent landing. Now, the fighter is ready for slow time. Ninety minutes of normal flight, during which the pilot stays within easy distance of the field, ever watchful for minor malfunctions. Actually, there is nothing slow about this type of flying, but on the other hand, no effort is made to reach the terrific speeds of which the craft is capable.

Throughout this testing program, the pilot is encouraged to be super-critical. Even the slightest failure to operate properly, on the part of any of the many instruments or pieces of equipment, is sufficient reason to postpone the rest of the test, until this item is again functioning as it should. Time-consuming? Yes. Expensive? Yes. Worthwhile? Absolutely!

FARNHAM SPAR MILLING MACHINES USED ON AIRCOBRA

Production of Airacobras was speeded considerably by the use of Spar Milling Machines supplied by Farnham Manufacturing Co. of Buffalo. The Spar Milling Machine produces wing spars at high speed, putting on the required taper and twist, and milling out portions of the web and flange for lightness. Time savings effected is said to pay for the machine on relatively small production orders of 50 planes or so.

Spar Milling Machines are produced in two different types, one for straight and one for twisted design spars. In the former the various heads impart vertical and/or horizontal motions from various templates as needed to produce the desired spar. In the latter, two or three heads are mounted in a cradle which is locked around the longitudinal axis of the machine in a plane perpendicular to this axis, under the action of a roller riding a template fastened to the side of the bed frame. The cradle is mounted in a cross head which moves vertically between guides under the action of a roller riding another template fastened to the side of the machine.

Interchangeable high-speed milling heads driven direct from integrally built motors, are provided in 5-10-15-20-25-30 h.p. sizes.

Farnham Spar Milling Machines have been supplied to Noorduyn Aviation Ltd., Boeing of Canada Ltd., and National Steel Car Corporation, in Canada.

BOOK REVIEWS

AIR PILOTING

By Virgil Simmons

One of these days, before I get too old, I would like to write a novel paying tribute to the Flying Instructor. In my opinion he is one of the most deserving, and at the same time dramatic, subjects a writer could choose to write about. Having gone through the flight instructional "mill" myself, it is a constant source of wonder to me that all flying instructors of a few years' standing are not grey-headed before their time. For flying students are as bad as babies at the crawling stage, you can't take your eye off them for a couple of minute or they are getting into trouble.

A schoolmaster has nothing on a conscientious flying instructor when it comes to downright efficiency. A good instructor is not only injecting you full of air-sense and common-sense when he has you in the air—he is passing out useful hints all the time you are around him. As he passes you in front of the administration building or hangar and sees that you are laughing at the antics of another student coming in for a landing, he seizes the occasion to say "Take that smile off your face, my friend—that could easily be you!" He is like a suction pump, constantly sucking off a quart of cockiness from your system, and replacing it with a pint of knowledge.

Looking back on the many instructors we have known, we read Virgil Simmons' "Air Piloting" with keen interest. The author, currently director of training at the Civil Flight School, Spartan School of Aeronautics, and formerly flying instructor at Boeing School and in the U.S. Army and Navy Air Services, is a veteran of his craft, and in this 758-page book he has left practically nothing unsaid that a beginner requires to make him a first-class pilot. His chapter on the responsibility of the flight instructor is especially good. Starting off with a chapter called "General Considerations", he records the Ten Commandments of safe flying, gives orthodox description of the aeroplane and its controls and their functions, devotes three chapters to preliminary instruction, and follows the student's career through intermediate instruction, advanced manoeuvres, the private pilot, the commercial pilot, cross-country flying, airways radio, instrument flying and rating, civil air regulations, meteorology, aerial navigation, and tacks on a chapter at the end which shows how much the pilot has to learn all over when he takes to seaplane flying. An appendix is devoted to questions which must be answered in a written examination for a commercial pilot's license.

The book is graphically and plentifully illustrated by sketches and photos. The handling is informative and direct, and each bit of information is presented in tabloid form, under a sub-heading. In the field of aerobatic flying, the author even passes along a recipe for an "aerobatic cocktail", useful for an air pageant. "(Aeronautical jag guaranteed!) For high-performance aircraft. Official sanction is required for exhibition purposes. At 18,000 feet altitude, vertical power-dive to terminal velocity; at about 8,000 feet (if wings have not pulled off) make smooth parabola to horizontal level and continue to vertical climb; at the 'top' (swallow hard) pull over on back and make precision inverted spin of 6½ turns; recover to normal level (cruising). Execute extra large advanced aerobatic figure eight, then follow immediately with a snap roll (2 turns) to left, precision spin 3 turns to right and 3 turns to left; snap roll (2 turns) to right; falling leaf (lose 1,000 feet); 3 inside and 3 outside loops; slow rolls to form horizontal figure-eight pattern (upper portion, left rolls; lower portion, right rolls); inverted falling leaf; inverted approach and normal landing! Note: Only one 'double A' cocktail is recommended to a customer!" **The Ronald Press Company,** 15 E. 26th St., New York City. Price $4.00.

BRITISH FIGHTER PLANES

By C. G. Grey

The author, who is recognized, we believe, as the greatest living authority on aviation brings his broad experience to bear on a fascinating discussion of the modern aircraft and the developments which led to its evolution. This is a book which will be read and enjoyed by veteran pilot and greenest aviation student with the same facility and pleasure, for C. G. Grey has a knack of conveying technical information in non-technical and interesting language.

His introductory sentence runs: "An examiner, according to legend, once asked a subaltern in a crack regiment of horse, 'What is the function of cavalry in war?' and the lad answered, 'To give tone to what would otherwise be a mere vulgar brawl.' "

The mantle of the cavalry of yesterday now rests upon the Fighter Squadrons of the Royal Air Force, Grey declares, and the modern fighter plane is like a thoroughbred horse, complete with its pedigree, and springing from a long line of distinguished aircraft. "Flying a Spitfire is like riding a well-trained race horse . . . and a Hurricane is like a perfect hunter."

He then goes back to the origin of fighters in the last war, recording how Britain was caught napping with insufficient armament in the first two years of conflict, but came back strong in 1916 to gain supremacy of the air over France. Development by development he chronicles the evolution of the fighter plane during the World War and after, up until this year. In his story interspersed with amusing anecdotes and little scraps of information that perhaps Grey is the only man alive to know about, he describes the first armament, first armor plate, first aerial cannon, first interruptor and synchronising gears for firing machine guns through revolving propellers, and a wealth of other accoutrements and how they came into being. The importance of the Fighter, and its twin-sisters the Interceptor and the Dive-Bomber are discussed, and the future of this type of aircraft. How land fighters were first adapted to Fleet work, and early methods of take-off and landing from a deck, are also dealt with. Guns, motors, anti-aircraft, night fighting, are all discussed by this expert, and then he launches into the main reason for writing the book, devoting a chapter to the heredity of each of a number of what he considers to be modern thoroughbred British Fighter planes; i.e., the Bristol Blenheim Fighter, the Fairey Fulmar, the Gloster Gladiator, the Hawker Hurricane, and Hawker Tornado, the Vickers Supermarine Spitfire, the Bolton Paul Defiant, the Westland Whirlwind. His book concludes by treating in similar fashion the pedigrees of the various aero engines currently in use in modern fighter planes.

This is C. G. Grey at his best, and "British Fighter Planes" should make a welcome addition to any pilot's or aviation enthusiast's library. Published by **Faber and Faber Limited,** 24 Russell Square, London. 200 pages. Well illustrated. Price: 5 shillings net.

Review of "Aircraft Engines of the World" in last month's issue carried no price. We have since been advised that the book sells for $7.50.

THE BELL AIRACOBRA——"Cannon on Wings"

LET'S GO! U.S.A. KEEP 'EM FLYING!

WE'RE GETTING THEM OUT!

Bell Airacobras at Selfridge and other army fields tell the story of how we've telescoped time. Every minute is doing double duty in our production. The Airacobra was designed for speedy assembly—ordinary manufacturing methods were discarded at the start. Our mass production system makes the *best* use of thousands of workers, and precision machines have been invented which cut hours down to minutes. It takes many people, working hand in hand, to accomplish our production . . . it's the co-ordination of their loyal efforts which makes possible the fast-growing number of Bell Airacobras.

BELL AIRCRAFT CORPORATION, BUFFALO AND NIAGARA FALLS, N. Y.
Bell Aircraft Ordnance Division

Making Aviation History

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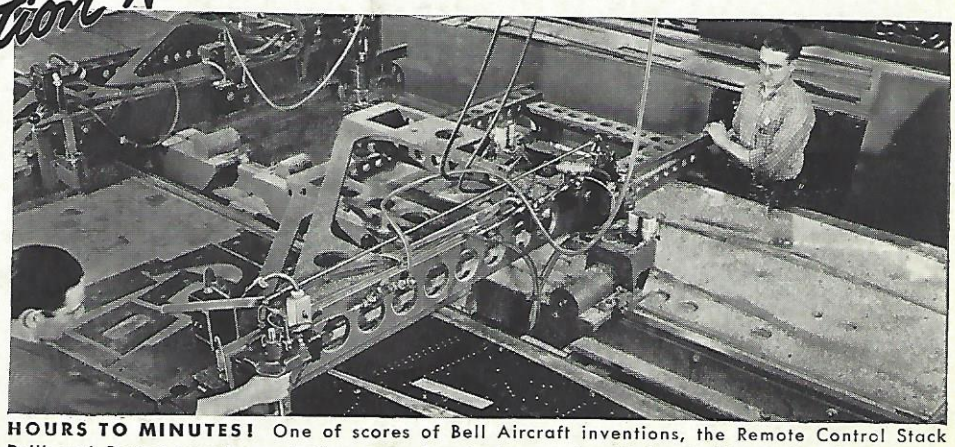

HOURS TO MINUTES! One of scores of Bell Aircraft inventions, the Remote Control Stack Drill and Router speeds production many hundred percent, with invaluable savings in material.

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