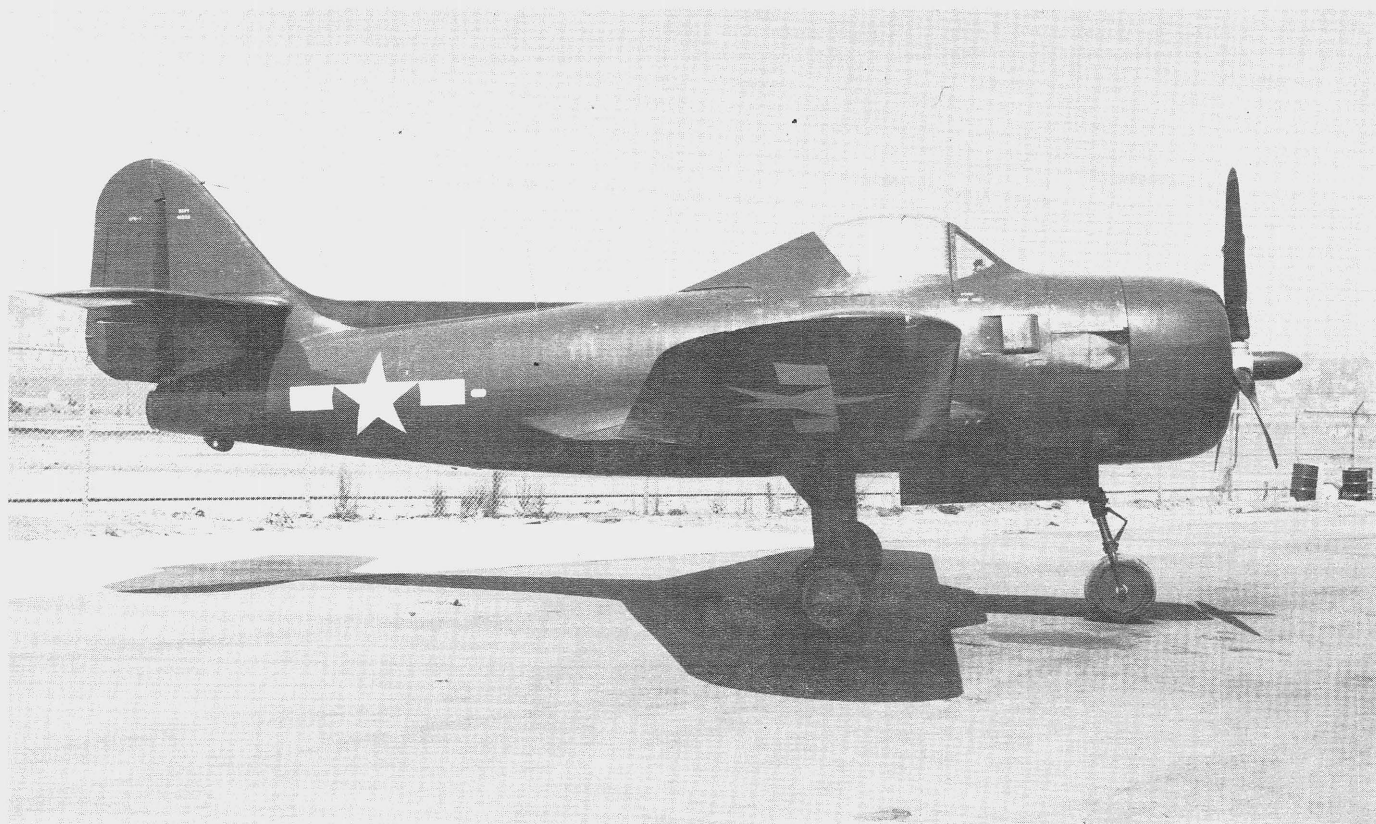




The Ryan XFR-1 Fireball, BUNO 48232, as it appeared when first completed with the original tail configuration in which the horizontal fin was attached well up on the small area vertical tail. (Photo - Ryan 28-1042)

RYAN'S FIREBALL

By ERNEST R. McDOWELL

The interest of the United States Navy in jet propelled aircraft began in 1942, the year following the first successful jet flight in England (the Gloster-Whittle E-28/39 flew successfully on 15 May 1941) and almost three years after the first jet flight in history took place in Germany (the Heinkel He 178 on 27 August 1939). This interest by the U. S. Navy was concurrent with the beginning of jet engine development in the United States; begun with British help that made the Whittle jet engine available to General Electric, and the design of the first U. S. jet fighter, the Bell XP-59A that first flew on 2 October 1942.

The officers in charge of the Navy's Fighter Planning desk were fully aware of these developments and the fact that, in due time, Naval aviators would be called on to face enemy jet aircraft in combat. They were further aware of the many problems incident to naval jet operations that would have to be overcome before jet aircraft could be expected to operate from aircraft carriers in the fleet. Early jets required long take-off runs and, due to their high touch-down speeds, longer roll-outs on landing. They also possessed a very high rate of fuel consumption coupled with short endurance. Further, their tricycle landing gear had never been used for regular carrier operations, and it appeared that catapult assisted take-offs would become a prerequisite for successful operations.

In total, these conditions of jet-carrier operations meant that aircraft carriers would have to be modified in a number of ways, would have to carry more fuel and that special flying skills would have to be developed.

The possibility of adapting the Navy's many, small escort carriers to handle jet aircraft seemed especially remote. Other solutions to the problem of introducing jet power to carrier operations were, therefore, investigated.

From such investigations one alternative solution came to the fore with the proposal for the use of a composite type aircraft - one that would combine both a jet engine and a conventional reciprocating engine in the same air-frame. It was hoped that such an aircraft could be designed to combine the best features of each power system, could be available for service much sooner, and could operate from any carrier in the Fleet. In such a composite aircraft, the jet engine would provide the extra power for added speed during combat, give the aircraft the high rate of climb of jet types, and give it operational capabilities at all altitudes. The conventional engine would supply the main power source for "normal" take-off and landing runs, for use in the wave-off condition, and for the most economical fuel consumption rate at cruising speed.

The merits of this composite aircraft proposal clearly offered at least a temporary solution to BuAer, headed by the late Admiral John S. McCain, in December, 1942. Consequently, a proposal for a composite type of Naval fighter airplane was issued. It was submitted to nine aircraft manufacturing companies including the Ryan Aeronautical Corporation, San Diego, California.

Ryan at once indicated their interest in the project, and a meeting between Ryan officials and the Navy was arranged. Within three hours after the meeting be-

gan, Ryan's Chief Engineer, Ben T. Salmon, had so thoroughly grasped the proposal that he was able to make a sketch on the back of an envelope that was extremely close in configuration to the airplane that was to evolve from these discussions. The Navy was so impressed by the swift grasping of the situation that Ryan was quickly selected to handle the project. Contract negotiations were conducted in January 1943 and Ryan was given the go-ahead by the Navy to begin work on the prototypes of what was now Ryan Model 28. The letter of intent was issued on 11 February and called for three airplanes (designated XFR-1 with stalling speed, take-off and landing speeds based on CVE - Escort Carrier - operations) complete with engines and propellers plus a static test article. Delivery schedules were placed at 10 months from the date of the letter of intent for the static test article and 14, 14 and 15 months for the three flight articles.

As work progressed on the first models, the Navy evinced further interest in the XFR-1 type (which received the name Fireball) with the issuance of Contract NOas-1322 on 2 December 1943 and calling for 100 FR-1 aircraft. An additional 600 examples were added to the contract later, but of the total of 700 aircraft only 66 were delivered and 634 were cancelled on VJ Day. The serial numbers of the aircraft delivered were 39647 to 39712 inclusive with Number 39661 modified to model XF2R-1 and number 39665 modified to model XFR-4. The FR-1s were all delivered in 1945--4 in January, 6 in February, 1 in March, 3 in April, 4 in May, 1 in June, 10 in July, 10 in August, 7 in September, 8 in October and 12 in November. On 31 January 1945, Contract NOas-5499 L.I. was issued for 600 FR-2 aircraft, serial numbers 104576 through 105175 being assigned. All 600 aircraft were cancelled on VJ Day.

With the Letter of Intent issued, Ryan assigned a design team headed by Ben T. Salmon to the XFR-1 project. William T. Immenschuh, now Ryan's Chief Engineer, was made the project engineer on the XFR-1. Vice President B.A. "Bud" Gilles was placed in charge of Operations while Vice President Earl Prudden was given the task of handling Administrations with Walter Locke as Contract Administrator. T. Claude Ryan's personal assistant on the Project was former Navy Commander Tom Jones.

Design and production proceeded apace on the first three XFR-1s and Ryan was able to stay quite close to the delivery schedules set forth in the Letter of Intent. The first XFR-1 took off for its maiden flight on 25 June 1944. In all, two flights were made that day, both with the aircraft being powered only by its piston engine as the jet engine had not yet been installed. This installation occurred almost immediately after the first flights, and during July the XFR-1 made several flights with the jet engine in place. The second aircraft made its initial flight on 20 September 1944.

The Ryan XFR-1 Fireball, that had now been produced, was a single place, low wing monoplane employing the first laminar flow airfoil intended for carrier operations and a retractable, tricycle landing gear. It was also the first Navy plane to have an entirely flush riveted exterior and all metal covered control surfaces. Armament consisted of four 40 caliber machine guns with 300 rounds per gun housed in the wing center section, and provision was also made for one (or two) 1000-lb bombs underwing. Wing span was 40'0", overall length was 32' 3/4", height to top of rudder was 12' 3 14/16", and gross weight was 8,667 pounds. The XFR-1's two engines gave it an all-altitude capability. In the nose was the reciprocating engine, a Wright Cyclone R-1820-72W, 9-cylinder, air cooled radial, developing 1350 hp for take-off. Mounted in the fuselage aft of the pilot was the centrifugal flow turbojet engine, a General Electric I-16 (later designated J-31) developing 1600-lbs static thrust.

The forward engine installation consisted of a chrome-molybdenum steel tube engine mount, a cowl made of two semi-circular sections of nearly equal di-

mensions with the junction line being slightly above the fuselage centerline, and an engine accessories cowl made up of a set of removable panels and cowl flaps. The semi-monocoque fuselage was made up of forward and aft sections. The forward section consisted of smooth stressed skin reinforced with vertical frames, bulkheads, longerons and stiffeners with fittings bolted to the lower extremities of the bulkheads providing for attachment of the wing center section.

The aft fuselage section (containing the jet engine and connected to the forward section by a four point attachment) was built as one unit for the first aircraft, but for production machines the forward part of this section was made in two half shells, split down the centerline vertically, and the aft part was split on the horizontal centerline in order to simplify the mating of tail surfaces and fuselage.

The jet engine was located in the forward portion of the aft fuselage and was mounted at three points by fittings located on each side of the engine and an overhead strut assembly. Just forward of the jet engine was a shroud consisting of an oval-shaped enclosure made of reinforced steel designed to direct the air into the air compressor intake. Aft of the engine was the exhaust tube made in three sections of .020 gauge steel.

In designing the air intake ducts three possible locations were considered: 1) nose location under the radial engine and using a elliptical cowl; 2) retractable duct entrances, and 3) wing leading edge duct entrances. The nose entrance location was discarded because of the complexity of working the ducting around the nose wheel and through the belly of the airplane. The retractable duct entrances were not proceeded with because of jet engine demands. The I-16 power plant required a low-speed, high-pressure type of entry which meant a plenum chamber had to be used. With the jet engine located just aft of the pilot, retractable duct entrances would have had to be located forward of the pilot's compartment, but there was no room for the ducting there, on either fuselage side or bottom, due to the fact that the arresting hook, catapult fittings and nose wheel were located in this area. The sides of the fuselage just forward of the leading edge of the wing could have been used but it was feared that a serious problem might be encountered with the airflow over the wings when the ducts were open.

So it was that the wing leading edge location for the ducts was settled upon, a location that did not require any mechanism to close the ducts and where they would be normal to the line of flight and in the propeller slipstream. As a further benefit, cooling air could also be brought in through the leading edge duct, and since the ducts would not be closed, would continue to cool the aft engine compartment after the jet engine had been stopped. The experience of other aircraft companies with wing ducts for oil coolers, etc. indicated that no serious problems of an aerodynamic nature would be encountered.

This duct design was first laid out according to some preliminary testing by the NACA at Langley Field, Virginia. A 1/5 scale model of the duct system was made of transparent plastic and a suction fan was developed by Ames Aeronautical Labs which pulled the correct air quantities through the 1/5 scale duct. The entire system was bench tested for static conditions and then installed in the wind tunnel model where it was very successful in simulating actual flight conditions throughout the entire speed range of the airplane. Since preliminary NACA testing did not take into consideration the effect of changes in the angle of attack which are necessary in an actual airplane, it was found necessary to develop new and modified duct entrance shapes during weight tests. When evolved, these were found to be surprisingly similar to duct shapes developed independently in British research labs.

Flight testing revealed that the effect of wing ducts upon the airplane's characteristics was surprisingly



With a dorsal fin slightly modified from the final configuration, the second XFR-1, BUONO 48233, is seen during a test flight over San Diego. The clean lines of the aircraft are quite evident. (Photo - Ryan 28-1680)

small. The drag of the duct entrances, when the jet engine was stopped, was only slightly higher than that of the undeformed wing. The pitching moments and lift coefficient developed were very close to that of the normal wing, and the critical Mach number was equally good. There was no apparent flow disturbance at the tail in any condition and no difficulties were encountered in flight testing through the use of the wing duct entrances.

The wing structure of the Fireball was semi-monocoque and full cantilever and consisted of two detachable folding outer panels, a center section which was integral with the fuselage, ailerons and inboard and outboard flaps. The center section was assembled integrally with the fuselage. The outer panels carried the ailerons, a wheel well located on the lower surface housed the main gear when fully retracted, and a retractable, main landing gear wheel door was hinged outboard of the wheel well. Strips of lead rivited to the leading edge skin of the aileron were used to balance the aileron, and a fabric seal was screwed to the leading edge of the aileron and trailing edge of the wing outer panel for aerodynamic balancing.

Choice of airfoils for the XFR-1 was influenced by several factors. First, since it had been decided that the wing duct entrances would be used, the main wheels had to be swung outboard when retracted. This meant that the wing had to be of sufficient thickness to accommodate the wheels at a rather distant outboard station. Accordingly, the airfoils chosen had a thickness ratio of 17% at the root and 15% at the tip.

The next problem was the selection of airfoils that had high critical Mach numbers and led to the use of low drag airfoils. Since the design team did not wish to have too high a wing pitching moment because of the high tail loads and the high wing torsional loads involved in such a selection, an optimum lift coefficient of 0.1 was used. To eliminate any shift of lift toward the tip of the wing when the wing root reached its critical Mach number, airfoils were selected in which the entire

wing reached its critical Mach number at the same time. This was accomplished by using an "a" line of 1.0 at the root and 0.5 at the tip. This, in turn, again reduced the wing pitching moments and torsional loads and, it was felt, reduced the tuck under tendency in high speed dives.

Test data for the 17% chord, internally balanced, sealed type ailerons initially indicated that the design had produced a very high effectiveness considerably in excess of the requirements specified by the Navy, and wind tunnel tests of two dimensional sections with ailerons had indicated that the XFR-1 would have reasonably light aileron stick force. However, subsequent investigations in the 40' x 80' full scale wind tunnel at Ames indicated this was not so. The reason for the discrepancy was found to be that the wind tunnel tests from which the aileron control force calculations were made had been done at a low Reynolds number and that, as a result, the boundary layer was much thinner than that encountered on the full size airplane. Since the balance of internally balanced surfaces is affected by pressures in the boundary layer at the aileron hinge line, any increase in boundary layer thickness reduces the effectiveness of the aileron balance. To aid in partially overcoming the low aileron balance, flat-sided ailerons were used. The cusp which is normally associated with low drag airfoil sections was removed to accomplish this, materially reducing the stick force and resulting in a more satisfactory aileron configuration.

Flight tests confirmed the wind tunnel tests regarding stalling characteristics. The low drag airfoil sections used gave the Fireball a considerable advantage over existing Naval aircraft in maneuverability, and turning ability at high combat speeds was outstanding. Flight tests were also made with spring tabs on the ailerons. Remarkably good results were achieved by using these tabs but they were not incorporated on any of the production aircraft.

Flaps on the XFR-1 consisted of an inboard and outboard flap panel with a vane attached the full span of

each. Wind tunnel test information available at the time of design indicated that Douglas double-slotted flaps would give the extremely high lift coefficients required for a carrier-borne aircraft. Their use also meant that the design team could use less wing area than would be permissible with other types of flaps. Therefore, Douglas double-slotted flaps were incorporated in the design, even though wind tunnel tests of the 1/5 model showed that the maximum lift expected would not be obtained. This was confirmed by initial flight tests which showed the double-slotted flaps did not produce the expected results.

Inability of the flaps to produce the maximum lift expected was felt to be due to slight deflections of portions of the wing and the flap. A little testing of the flap arrangement also showed that any errors in rigging or any deflection in the system in flight would destroy a portion of the expected lift. Simulated carrier landings indicated that the XFR-1 had an extremely high rate of sink, and when the flaps were deflected to the original 55 degree angle called for in the design, the sink was considered unsatisfactory and undesirable. Causation of this was held to two factors: 1) the flaps had a drag somewhat higher than originally indicated by the two-dimensional tests, and 2) the gross weight of the airplane, and therefore the wing loading, had increased. The high rate of sink would not have been objectionable in an Army airplane, the Martin B-26 having a higher rate of sink than the Fireball, but in carrier operations it was very unsatisfactory.

When the double-slotted flaps were limited to a travel of 35 degrees, the undesirable sinking characteristics were eliminated but the stalling speed was increased. A study of single-slotted flaps was then begun and indicated that single-slotted flaps deflected to 40 degrees would do just about as well as double-slotted flaps deflected to 35 degrees. This type of flap also offered a considerable simplification of the system and a weight saving, and it assisted in the lateral stability in the approach position and reduced the sinking speed.

Before settling on a change to the single-slotted flap, four sets of the new design were made in the experimental shops. The first set was static tested to destruction to correlate and establish its strength. The second set was installed on the flight test airplane. The third set was installed on the wind tunnel model, and the remaining set forwarded to the Patuxent Test Center, Maryland, and installed on the flight test vehicle at that installation. A considerable amount of testing was done including experimenting with such features as blow-up flaps to reduce the drag and improve the acceleration of the airplane in the wave-off condition, and several angles of deflection from 20 to 55 degrees were tried. After the final configuration was established (single-slotted flaps with about 40 degrees deflection) it was installed on all FR-1 aircraft. (The three XFR-1s and first 14 production machines had double-slotted flaps when completed, but all subsequent aircraft had the single-slotted variety.)

It is interesting to note that when some difficulties were experienced with lateral stability when the flaps were extended, the Navy requested Ryan to revise two aircraft - one to have two degrees of additional dihedral, another to have an additional four degrees of dihedral. The aerodynamicist felt that while two degrees additional might not harm the high-speed flight too greatly, four degrees of additional dihedral would be rather undesirable in that it might cause the airplane to develop slight Dutch Roll tendencies which would be risky in close formation flying. Flight tests however, were inconclusive since this aspect seemed to depend on the individual pilot's skill and experience. As the plane was already in production, no change in dihedral was made.

The tail group consisted of a horizontal stabilizer, elevator, elevator tab, vertical stabilizer, rudder and

rudder tab which were all metal structures, flush riveted with a smooth finish. The horizontal stabilizer, composed of a left and right assembly, and the vertical stabilizer were attached to the fuselage with bolts through fittings. The elevators and rudder were attached to the fixed surfaces by hinge brackets and bolts.

Initial design of the tail group was based on that of the Grumman Wildcat. It was reasoned that since the Wildcat was satisfactory in the wave-off and takeoff conditions, and was able to operate successfully from a carrier, that a similar airplane with a similar wing area and power should have a similar tail area. In the design of the XFR-1, however, there were a great many variables which were somewhat new to those who were engaged in its design, and as a consequence an error was made in the original location of the Center of Gravity of the airplane. This added to the deficiency of the tail group's design, and when the Navy stated the Wildcat was not entirely satisfactory in the wave-off condition, a new tail design was in order.

Wind tunnel tests were made on the 1/5 model (with the original tail group design - the horizontal stabilizer mounted on the vertical fin above the fuselage, and the elevators designed with an elliptical nose balance using the highest degree of balance that was felt to be safe), and the fact was clearly brought out that directional control was marginal in some cases. In the wave-off condition, for example, it was impossible to turn to the right with full power.

Directional stability was also slightly marginal. The reason for this is apparent upon close examination of the Wildcat and the XFR-1. The new aircraft had a circular fuselage which remained almost circular to the extreme rear of the airplane. On the other hand, the Wildcat had a fuselage which slimmed into a vertical knife-edge at the rear. This vertical knife-edge, in effect, gave the Wildcat a larger vertical tail area and, therefore, greater stability.

The horizontal tail of the XFR-1 was affected by the error made in locating the CG of the airplane, at about 19% m.a.c. The CG was finally located somewhere in the neighborhood of 25-26% m.a.c. This was a shift that dictated a considerable change in the size of the horizontal tail. Another factor influencing redesign was the little that was known about internal balance surfaces when the horizontal tail was designed. Even though the highest degree of balance that was felt to be safe was used, the wind tunnel tests proved it to be inadequate. Calculations were made to assist the stick forces by use of a balance tab. However, the balance tab also reduced the effectiveness of the elevators and it was apparent that it was a race between the reduction in stick forces and the reduction in elevator effectiveness.

With the aid of the staff at Ames Aeronautical Laboratory, it was decided to solve the problem of the horizontal tail balance by using a sealed, internal balance. Wind tunnel tests of this surface indicated that it had excellent characteristics, both as to stability and control. A new vertical tail was tested in the wind tunnel before being incorporated on the actual aircraft, and with it the turn to the right in the wave-off condition was slow - but positive. The tail cone was also redesigned placing the horizontal stabilizer and elevators on the fuselage. At the same time, area was added to the horizontal tail to increase the aspect ratio.

Some flight testing was done with the original tail even though it was known that this tail was unsatisfactory. It was felt that a good many other details on the airplane, such as engine operation, aileron control force and general shake-down items, could be accomplished without undue risks and without waiting for the new tail which was being built.

Attempts were made with the new tail to improve the slow turn to the right in the wave-off condition. Various configurations were tried, including a higher

word reached the plant that Bob Kerlinger had suffered a fatal crash when his plane broke up in flight.

Subsequent investigations were unsuccessful in pinning down the exact cause of the accident, but Mr. Immenschuh states that he has long held the opinion that Bob Kerlinger exceeded the buffet boundary layer (compressibility limit) of the airplane without being aware of it or realizing it only when it was too late. This theory is backed up by the fact that the XFR-1 was a very clean airplane, aerodynamically speaking, and with very little being known at the time about compressibility effects, it could very quickly have gone to a speed where the aircraft would shake itself to pieces.

Al W. Conover, the Ryan Research Manager, who succeeded Kerlinger as Chief Test Pilot, subsequently carried out a series of demonstration dives on an XFR-1 in which the speed was carefully built up. These tests showed that certain portions of the aircraft could go into compressibility that caused very severe structural loads sufficient to break up the airplane.

Five months later, during a test flight on 25 March 1945, a second Fireball was lost and the test pilot killed. The pilot was M. G. "Mickey" McGuire. He started a dive at 35,000 feet but was unable to recover from it although the airplane did not break up prior to impact. The only witness was Dean Lake, who was flying escort to McGuire, and he could throw little light on the subject of what had happened as he was some distance from the other plane at the time of the accident. Investigations of the crash also failed to locate a satisfactory explanation for the accident. Mr. Immenschuh, however, believes that Mickey McGuire may have found himself in the same type of situation that confronted Bob Kerlinger. McGuire apparently avoided the extreme conditions that would have resulted in the aircraft breaking up in flight, but may have encountered a situation whereby he did not have sufficient elevator power to pull out of the dive.

FLIGHT TESTING PROGRAM

The Flight Testing Program for the Fireball was broken down into three phases--first, preparing the program and instrumenting the airplane so that accurate data could be obtained with a minimum of delay; second, conducting the actual test flights; and third, reducing the data and compiling summary reports for submission to the Navy familiarizing them with the airplane so that their operational difficulties were kept at a minimum. The Program was broken down into the following categories:

GROUND TESTS - These were run to functionally check the engine, or engine and controls, prior to flight and to ascertain that flight test instrumentation was operating satisfactorily.

FAMILIARIZATION FLIGHTS - Approximately 5% of the flight test time was devoted to familiarizing the pilot with the airplane before he actually got into the test program.

PERFORMANCE - Some 20% of the program was devoted to studying performance. It was important that some of these tests be made at the beginning of the program because of the close relationship between performance data and other phases of the testing program. It was also desirable to verify calculated performance figures as soon as possible.

STABILITY AND CONTROL - About 15% of the time was allotted to stability testing and another 15% to control problems. These tests required elaborate instrumentation set-ups to insure that the data was standardized for all pilots.

ENGINE PERFORMANCE - A further 15% of testing time was allocated to engine performance. This time was spent in checking the engine installations since engine performance had been established by the manufacturer.

FUEL CONSUMPTION AND RANGE DETERMINATION - No more than

10% of the flight testing time was allotted for these tests as they could be run concurrently with other phases of the program.

PROPELLOR VIBRATION TESTS - Some 5% of program time was set aside for testing various types of propellers. These tests were run independently of the propeller performance tests and instrumentation was furnished by the propeller contractor.

DEMONSTRATION - 10% of flight time was given to this activity. The demonstrations were made to verify contract guarantees and naturally were not begun until the Fireball had been thoroughly flight tested.

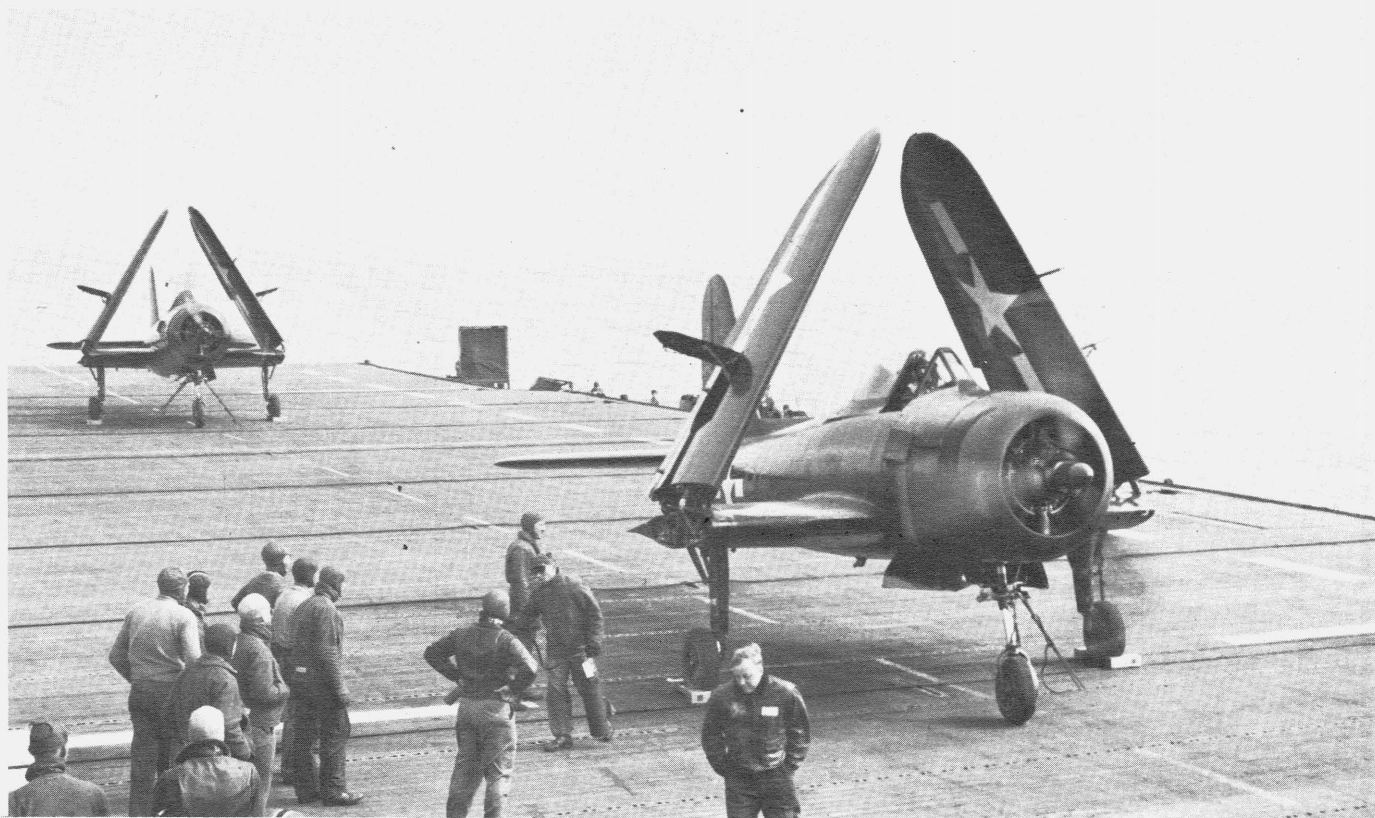
MISCELLANEOUS - The remaining 5% of the testing time was used to run miscellaneous tests which were scheduled as a result of later engineering information or changes, familiarization of other pilots with the aircraft, etc.

No difficulty was encountered during the initial performance tests. The first XFR-1s lived up to expectations and this phase of the flight testing syllabus was completed on time. However, later changes on the airplane made to accommodate discrepancies encountered in other phases of the test program, affected the performance figures to a point where some of the tests had to be re-run. A prime example was the effect that engine cooling problems had on maximum speed. Since the basic concept of the Fireball was to operate on the forward engine at all times and to use the jet engine to augment combat power, much of the engine performance testing settled on the forward engine. During the most critical altitude determination tests and rate of climb tests, it was discovered that the front engine was not cooling properly. A number of remedies were then tried including opening the cowl skirt, omitting sealing strips, and installing fixed louvers to allow more air to pass over the engine. All of these had adverse effects on the top speed and a big step toward solving the cooling problem was taken by installing electrically operated cowl flaps which allowed the pilot an adjustment by which he could control engine cooling. This, plus other modifications necessary for the production aircraft (notably the elimination of putty to smooth over the countersunk rivet heads which had created a near perfect finish), lowered the maximum speed of the production FR-1 to 419 mph from the original top speed of the XFR-1 which was 430 mph.

Performance of the jet engine was covered by a requirement in the demonstration specification which stated Ryan would make a complete survey of the jet installation in the FR-1. This was done by instrumenting the inlet ducts, the General Electric I-16 jet engine itself and the tail pipe. Runs were made at various altitudes and power settings with both the forward engine operating and with the engine shut down and the propeller feathered. A photo recorder was used to collect pressure data at all pertinent points and a Brown temperature recorder picked up all pertinent temperatures. This data was compiled into graphical and tabular form and submitted in the preliminary demonstration report.

Fuel consumption and range determination tests consisted of a series of prolonged flights in which power setting, mixture control and altitude were varied. Fuel consumption was accurately checked against time, and curves were plotted to indicate results. In the FR-1 tests, several flights were made to check the calculations made of fuel consumption. These checks verified the calculated curves so well that these were used rather than the flight test results.

In Ryan's case the Navy made an addendum to the basic specification, SR-386, for demonstration requirements because the Fireball was considered unconventional and because it was necessary to demonstrate the jet installation. The jet tests were not made on the aircraft used for dive tests (which was instrumented with a photopanel and a V-G recorder) but rather on an aircraft that carried only the instruments necessary to calculate jet thrust and performance.



Two Ryan FR-1s of VF-66 on board the USS Ranger during carrier qualification trials. Wings folded, engines are run up while Fireballs are still tied to the deck. (Photo - Ryan 28-4624)

Preliminary demonstration of the FR-1 to the Navy did not begin until 7 September 1945. The first production planes had gone into squadron use beginning in March 1945 with VF-66 following pre-delivery testing by Ryan for the Navy. While working up on the type VF-66 also tested the airplane, all this being done in a state of rush to prepare the Fireball for early service use against Japan. When the Pacific war terminated on 15 August 1945, a return to more leisurely testing procedures was made, and this testing phase for the Navy was begun at Patuxent River on 7 September 1945.

Al W. Conover was selected to conduct the demonstration and he elected to complete the spins first. An 8-foot spin chute was attached over the tail-pipe, with the control for the opening and jettisoning mechanism located in the cockpit, as wind tunnel tests had indicated some difficulty might be encountered in recovering from a clean condition spin. Conover, however, felt certain that the aircraft could be recovered easily from the build-up to 4-turn spins, which he would be required to demonstrate, as elevator control was available during most of the spins. The actual spin of the Fireball was an uncomfortable maneuver because the rudder and elevators became unstalled at about three-quarters of a turn. This allowed the airplane to flatten out and yaw violently until these surfaces again stalled. Then, the airplane lurched into another turn and the procedure repeated itself. The aircraft spun with what might be considered a series of snap rolls, but it was possible to recover in one-half a turn by applying normal recovery procedures with the controls. With the gear and flaps down the FR-1 spun more conventionally, the nose stayed down and there was no whipping as the wings rotated.

It was not possible for Conover to obtain an inverted spin, even with power on. The elevators would become unstalled as soon as the nose dropped from the inverted stall, and the airplane would then roll into a vertical dive. In attempting to spin out of a loop, Conover was only able to obtain an outside snap roll by applying

inverted spin controls at the top of the loop. From this it was concluded that the airplane would not spin while inverted. Throughout the spin test phase it was never necessary to use the chute.

Following the spin tests, the dive program was begun. The low altitude, high-G dives came first and rivet slippage was encountered during the $7\frac{1}{2}$ -G or limit-load dives. The rivets affected were the machine countersunk type and were working at the skin attachment points on the front and rear spar caps and were inspected continuously during the preliminary demonstration. As the dive program progressed, the constant working of the wings under applied accelerations made necessary the replacement of several rivets and caused some slight wrinkles to appear in the top skin of the outer panel. These troubles were corrected by doubling the number of rivets.

Although the dive program was concluded without further troubles with the airframe, Ryan and BuAer decided to repeat two of the high-G, high speed dives with new wing outer panels installed in order to be certain that the rivet joints were satisfactory. After these additional dive tests the wings appeared to be in a satisfactory condition.

Next, Ryan was requested to demonstrate seven high-G dive recoveries with a full 100-gallon drop tank installed under the right wing. Two of these recoveries were to be made with full aileron deflection applied at the point of maximum acceleration--this rolling, dive recovery requirement being added by the Navy as a number of aircraft had been lost in service through structural failure when carrying out such a maneuver in low altitude bomb delivery. The airspeed of the dive recovery was to be the "maximum attainable", but Ryan was unable to locate results of any tests which had been run previously under these same conditions so they were at a loss as to what speeds to attain. They then requested the Navy to allow them to run a series of tests on another airplane with an oscillograph and strain gauges installed in the wing structure and the sway brace supports



A Fireball comes in nose high with hook extended and reaching for arresting wires during the qualification trials on board the USS Ranger, run during the first days of May 1945. (Photo - Ryan 28-4754)

holding the drop tank. Calculations indicated that the G.F.E. sway brace would be the critical structure during the rapid rolls and the oscillograph verified this after some 14 dives were made. The maximum load that could be applied on the wing structure by abruptly displacing the ailerons amounted to only one-third of the design load for that area. However, the sway braces were considerably more critical and the tank itself was deformed at the sway brace attachment points.

Results of the preliminary demonstrations were compiled and the report submitted to BuAer on 19 November 1945. It was not until the first part of March that the Fireball was released for final demonstrations at Patuxent River. The demonstration was repeated for the Board of Inspection and Survey at that station. The spins were run without the spin chute installation and the dive program was concluded satisfactorily except for a few minor incidents. Finally, on 6 April 1946 Patuxent acknowledged that the final demonstration had been satisfactorily completed. They had made some 36 flights in 14 days with most of the hold-up between flights being caused by reading the photopanel film and compiling the necessary data.

In the FR-1 Fireball the Navy had an aircraft capable of engaging the enemy at any altitude from sea-level to the sub-stratosphere. It had tremendous power available, attaining its maximum efficiency when both engines were used together at full throttle. This gave it a performance more nearly independent of altitude than any other aircraft of the period and an extremely high and sustained rate of climb. The FR-1 cruised on the forward engine alone obtaining better than six miles per gallon for a maximum range of 1500 miles. It could also be flown on the jet engine alone in case combat damage or operational failure required stopping the forward engine and feathering the prop.

High speed maneuverability, with the shortest turning radius at comparable speeds of any combat aircraft, put it at the top of its class. In tests at 200 mph the FR-1 could turn with the most maneuverable Navy fighter

in existence, at 300 mph it turned well inside, and at higher speed it outmaneuvered the other fighter in shallow, medium and steep turns, as well as in climbs and dives. In a slow roll it was not necessary to apply full aileron, and the rate of roll was almost twice that of the Messerschmit Bf 109, for example, and was accomplished with far less effort than that required by a Bf 109 pilot.

Dean N. Lake, one of the test pilots who was active in all phases of the Fireball program, rates the FR-1 as better than other Naval airplanes of the period. Lake had tested FM-2s, SB2As and SB2Cs during his test pilot career and had about 250 hours of flying time on the Fireball project. He flew many take-off tests and reports the FR-1 was never able to take-off on jet power alone although many landings were made with just the jet engine in operation. He found the Fireball to be highly maneuverable, to have an excellent rate of climb and to be outstanding, in that high speeds were possible both at sea level and at operational altitude.

On 5 April 1945, Lake made a high speed demonstration run over Lindbergh Field in XFR-1, BUNO 48234, but suddenly, as he swept over the runway, the canopy blew off. Instinctively he pulled the nose up and the XFR-1 began to roll. A second later, Lake released his safety belt and was thrown free of the gyrating plane. His chute opened and he landed on the runway--the plane crashed into a new PB4Y further down the field. An investigation of the accident showed that the skin of the lower wing had pulled free at the leading edge (occasioned, like rivet slippage, by the fact that when the outer skin was countersunk to take the flush rivets, the inner extremity of this skin became knife sharp and worked against the rivets with a cutting effect when the wing was under heavy stresses), air had rushed through the wing opening and up into the fuselage, blowing off the canopy as the wing structure began to disintegrate. This accident was reminiscent of the death of Bob Kerlinger--post accident investigations of that crash had shown Kerlinger sustained a blow to



Airborne on its first flight is the Ryan XF2R-1 Dark Shark, BUNO 39661, taking off from Lindbergh Field, San Diego, California. Main difference from the FR-1 was the turboprop engine. (Photo - Ryan 29-102)

the head which could have come when his canopy blew off. These two accidents, therefore, may have stemmed from the same cause.

Six months later, 10 October 1945, Lake was again forced to bail out of an FR-1. This occurred on the down-wind leg of a landing approach when a fuel cell ruptured and flooded the cockpit with fuel.

During 1945/46, as development and testing progressed on the type, modifications were carried out on several of the FR-1 airframes. One was given a Wright R-1820-74W of 1450 hp and became the XFR-2. The designation XFR-3 was allocated to a Fireball that was to have a General Electric I-20,2000-lbs static thrust jet engine, but no aircraft was so modified. BUNO 39665 was given an extended fuselage, 8 inches longer than that of FR-1, which housed a Westinghouse J-34 jet engine of 4200-lbs static thrust, had flush entry inlet ducts on the side of the fuselage replacing the wing ducts of the FR-1, and was designated XFR-4. This aircraft was intended to be a test vehicle and forerunner for the XF2R-2. Two FR-1s that were to be sent to the USAAF for evaluation were never delivered.

A major modification of the basic Fireball design led to the Ryan XF2R-1, Dark Shark. This aircraft was the result of NavAer SD 399 which called for a single seat, fighter landplane with provisions for the forward engine to be a gas turbine unit driving a propeller and the aft engine to be a jet unit. FR-1, BUNO 39661, was converted to this configuration, and despite the fact it was not fitted with arresting gear, folding wings, catapult gear and various other equipment standard on the FR-1, it had a gross weight of 11,000 pounds compared to 9,862 pounds for the production FR-1. In November of 1946, the XF2R-1 became the Navy's first turboprop aircraft to reach the flight testing stage.

The Dark Shark was fitted with a General Electric XT31-GE-2 turboprop engine in the nose developing 1700 hp plus 550 pounds of thrust and had a J31-GE-3 jet engine rated at 1600-lbs static thrust as the aft power

source. With the new power plant in the nose, length was 36 feet, four feet longer than the FR-1, and the vertical fin area was increased by a larger dorsal fin. Maximum speed at sea level was approximately 500 mph, service ceiling was rated as 39,100 feet, and rate of climb was about 5,000 feet per minute.

The Dark Shark was fitted with a huge, four bladed square tipped Hamilton Standard Super-Hydromatic propeller (diameter, 11 feet) which made possible a new system of "braking" the speed of an airplane in the air. The rate of pitch change was extremely fast, and full feathering of the propeller or reversing it to a zero blade angle could be accomplished in a matter of seconds. The flatter blade angle created reverse thrust during the final landing approach and increased the drag thereby giving a steeper gliding angle and markedly reducing the landing roll. This system proved so efficient that Al Conover felt, after testing it, that normal runway landings could be made in a distance no greater than the length of a Midway Class carrier.

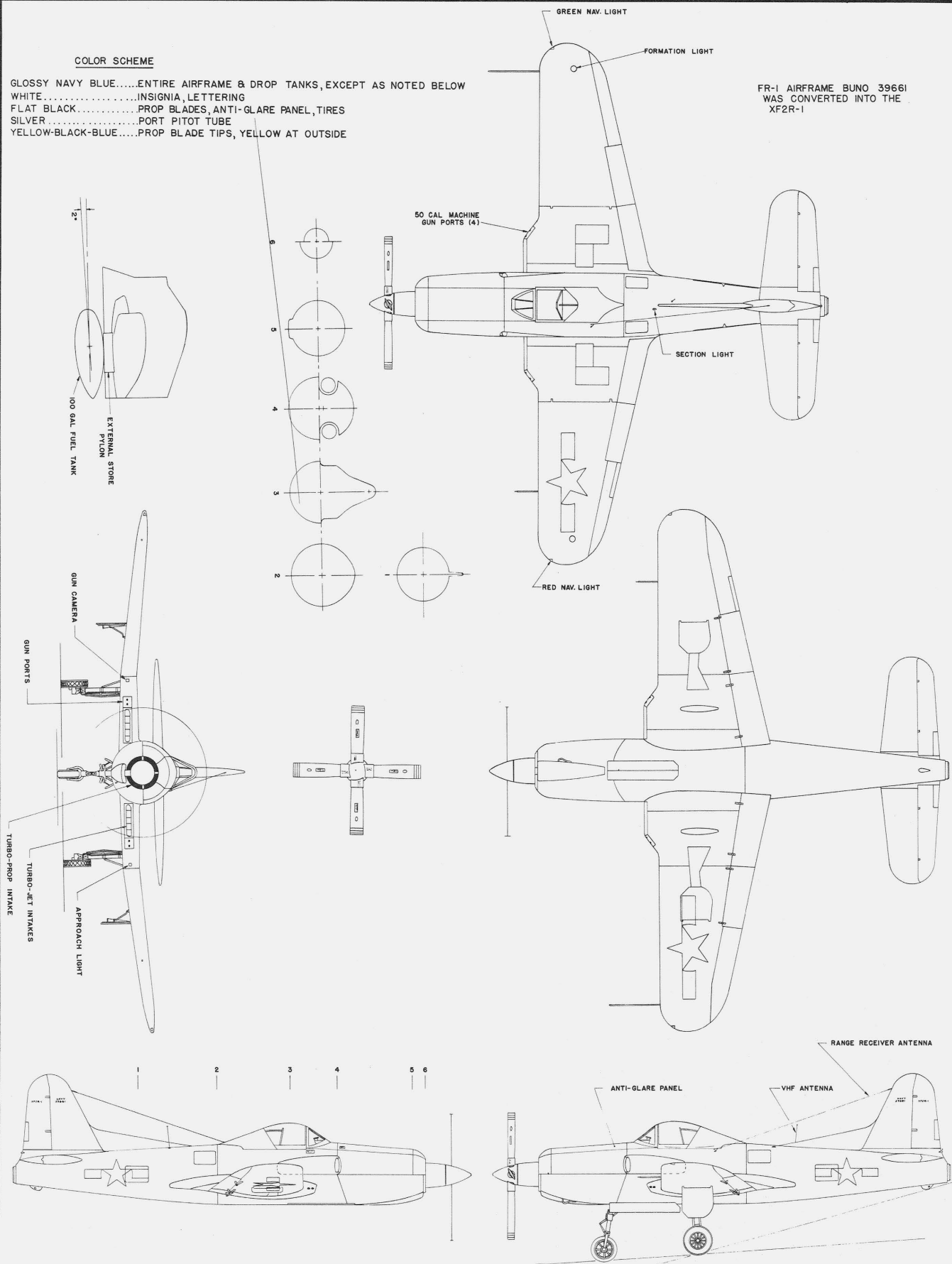
The Super-Hydromatic propeller had an automatic adjustment coordinated with the throttle to change blade angle from normal operating pitch to the flatter pitch position when power was reduced for a landing, thus converting it to an effective brake in the air to reduce speed. It also incorporated a tie-in circuit to the landing gear so that the propeller could immediately be changed to an even flatter angle when contact with the runway was made, thus reducing the landing roll to an absolute minimum. Due to the great inertia of the spinning turbine wheel, which turned for a long time at high rpm even after the engine was shut down, the propeller without the flat pitch feature would have pulled the airplane far down the runway, even against the holding power of the landing gear wheel brakes. Use of this propeller marked its first installation on a single engine aircraft as previously it had been used only on large, multi-engined aircraft.

The Dark Shark, like the Fireball, was capable of flying on its jet engine alone. In such flights the

COLOR SCHEME

GLOSSY NAVY BLUE.....ENTIRE AIRFRAME & DROP TANKS, EXCEPT AS NOTED BELOW
 WHITE.....INSIGNIA, LETTERING
 FLAT BLACK.....PROP BLADES, ANTI-GLARE PANEL, TIRES
 SILVER.....PORT PITOT TUBE
 YELLOW-BLACK-BLUE.....PROP BLADE TIPS, YELLOW AT OUTSIDE

FR-1 AIRFRAME BUNO 39661
 WAS CONVERTED INTO THE
 XF2R-1



DRAWN FOR AAHS JOURNAL
 BY
 W.A. EBERSPACHER 11-26-63

FEET
 INCHES
 CENTIMETERS

RYAN MODEL 29 "DARK SHARK", XF2R-1
 RYAN AERONAUTICAL CO., SAN DIEGO, CALIF.

propeller was feathered by changing the blade angles so that their chord lay in the direction of the line of flight. In this position they acted as brakes to stop turbine wheel rotation and at the same time offered the least possible amount of drag on the airplane.

THE FIREBALL IN SERVICE

When the Fireball had first flown and production aircraft were on the line, Fighter Desk was faced with the task of determining the best method of getting the fighter into operational status with the Fleet at the earliest date possible. The most logical step seemed to be the formation of a special squadron staffed with the best available personnel for the task of working the FR-1 up to operational status.

The first step was to select a Commanding Officer to skipper the new squadron and allow him to hand pick his men. This task was made much easier than it might otherwise have been, because at the time Lt. John F. Gray, the hard-hitting Exec. of the famed "Fighting Five", was in San Diego awaiting an assignment. He and his combat team had just completed their tour of rehabilitation duty and were awaiting assignment to another tour of combat duty. Gray's team consisted of Lt. R. D. Nicolin and Ensigns Eugene O'Neil, J. R. Mackay and H. F. Steele, Jr.

Gray was the leading ace of Fighting Five with a total of 24 enemy aircraft destroyed, 8 $\frac{1}{2}$ in air-to-air combat. In addition to his skill as a pilot and leader, Gray had the background that made him an ideal candidate for the assignment. He had attended the University of Illinois and taken two years of mechanical engineering work. He had earned an A.B. degree in psychology, graduating with honors. He then entered the Navy and won his wings and commission at Pensacola on 11 July 1940.

His active duty as a Naval Aviator began with a tour at Jacksonville, Florida. He was then transferred to Banana River, Florida and joined VS-ID-7, flying OS2Us on anti-submarine patrols. On several occasions Gray participated in attacks on enemy submarines during this tour, and he received a commendation from COMGULFSEA for his rescue of a British seaman while with VS-ID-7. He landed his aircraft on the open seas when he spotted

the victim of a torpedoed vessel on a liferaft. The seaman was suffering from exposure and a broken leg. Gray had to set the leg on the bobbing raft before he could get the man aboard his aircraft.

Shortly after this, Gray was selected as the Senior Officer of the first unit of the United States to provide active defense of the Bahamas. While the job was an important one, John Gray was still looking forward to joining a combat outfit and his chance finally came. He was transferred to VF-5, skippered by Lt. Cmdr. Charles Crommelin, and based aboard the USS Yorktown (CV-10), as Flight Officer and later as Exec., Gray took part in 30 combat missions. He saw action with VF-5 in the Marcus Island raid of September 1943, and this was rapidly followed by the raids on Wake Island, the Gilbert Islands, the Marshall Islands, Truk, Saipan, Palau, Hollandia in early 1944, and a return visit to Truk. Fighting Five had completed their tour with a 95-1 victory record, one of the best posted by any squadron. Gray's record made him the top man in VF-5.

During this tour, Gray flew one of the very first experimental VF(N) night flights. This was during the period that the famous Cmdr. Edwin H. "Butch" O'Hare lost his life doing the same type of flying. Gray was awarded the DFC and two Air Medals for this and his other exploits during his combat tour. He was well liked and popular with officers and enlisted men alike which was a bit unusual since he was a perfectionist, and as a result, was often demanding when he made an assignment. The job had to be done the correct way even if it had to be done over. He would not accept any half-way measures. Thus Gray brought not only a fine combat record, but a reputation as a good organizer to the task of organizing the Navy's first jet fighter squadron.

Quite naturally his combat team formed the nucleus of the new squadron. Lacking an official designation, they called themselves the VFX-1 and this appellation stuck with them during the formative months of October, November and December of 1944. Gray and Nicolin both felt that the squadron would mark a turning point in the concept of fighter tactics and deployment and were happy to accept the challenge it presented. Their squadron air strength during the period consisted of a mere six FM-2s. The FM-2 complement was later increased to 12 and eventually to 18.

On 1 January 1945, the Navy gave the squadron its official designation, VF-66, and the squadron later added to this its nickname--The Firebirds. While awaiting designation, Gray had been busy hand picking his personnel. From Fighting 24 he was fortunate in obtaining Lt. Collin Oveland, a fine combat pilot with five kills to his credit, and in addition, one of the finest engineering backgrounds in the Fleet. Fighting 2 was persuaded to part with two of their outstanding men in Mike Wolf and Rocky Robinson, and they headed up VF-66's new gunnery department. The great Task Force 58 air team provided other combat-wise pilots including "Duck" Palmer, "Dixie" Mays, "Willie" Schwall and "Rufe" Henderson. From the Philippine Islands group, Gray managed to get another ace in Kenn Hippe, along with Bud Weiss and Neil Albright. The net result was that VF-66 wound up with slightly over 70% of its pilots possessing combat experience and the Squadron had five aces on its roster--Gray, Wolf (with seven air-to-air kills) and Oveland, Hippe and Robinson (with five air-to-air kills). Gray also selected a few men who lacked combat experience, to enable the Navy to determine if men just out of flying school could make the transition readily and to get a bit of new blood in the outfit.

In January 1945 Jim Swope, another top-ranking ace with ten Japanese aircraft to his credit, and Duane "Whitey" Krueger, a fine pilot with an outstanding record, were added to the ranks of the Firebirds. Gray picked his enlisted personnel with equal care, and a large majority of them were combat-experienced veterans.

When the Squadron reached full strength, an



Lieut. Comdr. John F. Gray, the first commanding officer of VF-66, the Fireball squadron.

indoctrination course was set up at the Ryan Plant. Under the guidance of Chuck Therrin and Mr. Balch, the men of VF-66 spent a month of intensive training at Ryan learning as much as possible about the new airplane they would be flying or servicing. At the end of this period the squadron felt they were more familiar with the FR-1 than they had been with any previous aircraft they had operated. They'd been able to see the airplane being produced, talk with the designers, engineers, and production men at the plant, and to work on the aircraft as well.

Skipper Gray and Exec. Nicolin now initiated an accelerated program of flying and ground schooling aimed at producing the most thoroughly trained squadron in the fleet. The pilots flew the FM-2s to keep their flying skills sharp and to get used to flying together as a squadron and as combat teams. In March 1945, under grey cloudy skies the Skipper buzzed the field in the first Fireball delivered to VF-66 with both engines going full blast and a vapor trail extending hundreds of feet behind the aircraft. He proceeded to demonstrate what the Fireball could do.

With the delivery of its first FR-1 the Squadron was able to start a further program of indoctrination and familiarization on the actual aircraft it was going to use. The outstanding performance soon had the pilots enthused about their new fighter--the speed was an eye-opener, the rate of climb almost unbelievable, and for maneuverability, there was nothing in the Fleet to match it at high or low speeds.

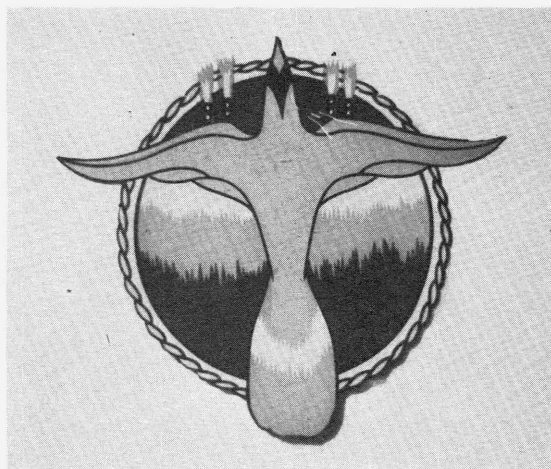
Fighting 66 now took its old FM-2s and moved to Twenty-Nine Palms, California for gunnery and rocket training on 2 April 1945. The available FR-1s were to remain at San Diego and arrangements were made to fly small groups back and forth between the two cities so that they could continue to train on the FR-1s and still take part in the gunnery and rocket training program. The word was that VF-66 was to be rushed into combat shortly to provide fleet protection against the Japanese Baka Bombs which only an aircraft with the Fireball's speed and maneuverability could catch.

During its period at Twenty-Nine Palms, two squadron pilots, Neil Albright and Harry Steele, set individual records in gunnery practice and the Firebirds came within a fraction of a point of breaking the all-time gunnery record for the West Coast area. During the 30-day stay in the desert, nine new pilots joined the Squadron and started training with it. The plan was to have these new men remain behind when VF-66 was ordered into combat to form a partially trained nucleus as a beginning of the next Fireball Squadron.

With more Fireballs coming to the Squadron all the time, VF-66 hoisted three of its FR-1s aboard the USS Ranger on 1 May 1945 for carrier qualification trials. A small, select group of pilots and enlisted supporting personnel was hand-picked for this operation, and Gray, Nicolin, Oveland, Mays, Schwall, Hippe and Reeder went aboard the Ranger with their crew of enlisted specialists to conduct this phase of FR-1 testing. Three days later, they were back and the necessary data for sea duty had been obtained. It was felt that the FR-1 could be successfully operated from carriers.

The month of June brought the Squadron its first accidents and casualties. Ensign Eugene O'Neil, on a routine test flight, crashed into the Pacific Ocean and was killed. The reason for the crash was never determined. A week later, Ensign Donald Beckwith lost power in his front engine on takeoff, and he spun into the sea and perished in the resulting crash.

During July, Nicolin was relieved as Executive Officer by Lt. Cmdr. William Elliott, who was the only Annapolis graduate to join the Firebirds. Under Elliott final preparations were made for an early departure to forward combat areas. The Squadron conducted accelerated flight tests at an unprecedented rate to accumulate the necessary data for the Engineering, Gunnery and Flight Departments. Then, one gloomy morning, 12 FM-2s



The Firebird Insignia of VF-66 as it appeared when made up as an aircraft decal.

were hoisted aboard the Ranger and every pilot put in practice flights. Those who had not previously qualified for carrier operations, made the required number of landings for carrier qualifications. During its cruise aboard the Ranger, the Squadron made a grand total of 407 landings and 74 catapult takeoffs without any serious accidents. This was a record they were justly proud of since it indicated they were jelling as a squadron.

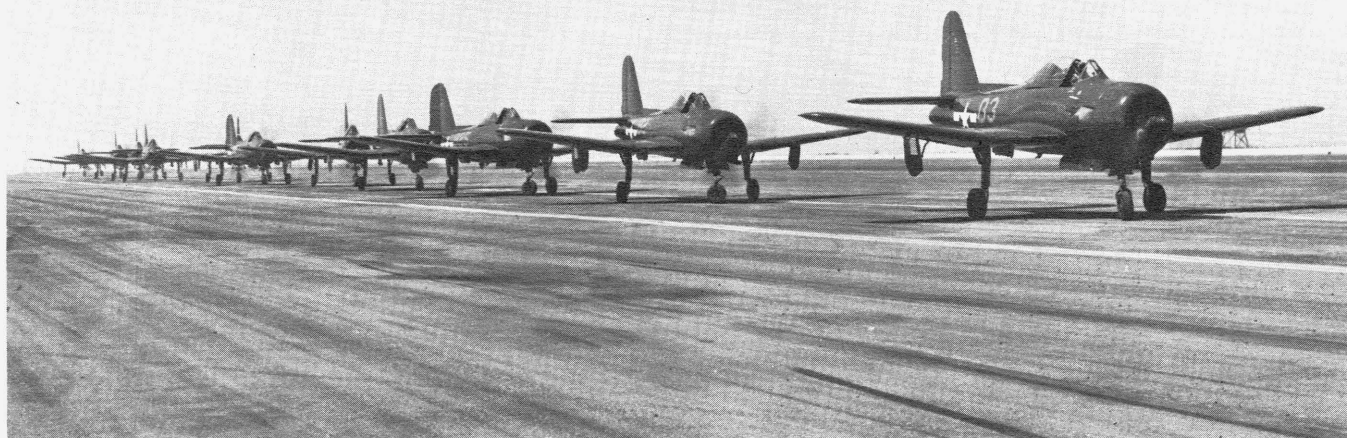
Shortly after the Firebirds returned from this training mission, however, World War II came to an end. The cessation of hostilities ended any chance of obtaining a combat evaluation of the Fireball, but the Navy decided to continue the program--at a more leisurely pace. The Navy still wanted to see the Squadron become operational with the Fleet and planning proceeded accordingly.

The Navy officially unveiled the Fireball to the general public in ceremonies held simultaneously on both the East and West Coasts on 26 September 1945. Pilots of VF-66 took part in the introduction ceremonies on the West Coast putting on an aerial demonstration at NAAS Brown Field. The Squadron gave demonstrations of precision formation flying and showed the maneuverability of the Fireball in a series of aerobatics. Less than a month later, 18 October 1945, VF-66 was decommissioned and what may have been the Navy's greatest fighter squadron, was no more.

With the decommissioning of VF-66, all planes and personnel were transferred to VF-41, thus preserving a continuity of fleet assignment for the Fireball. The Firebird insignia and name were also transferred to VF-41.

The end of the war brought about many personnel changes to the Firebirds as men received their discharges and returned to civilian life. However, the Squadron was receiving replacements to maintain its strength level, and pilot training was being intensified. The added training was pointed toward the day when the pilots of VF-41 would be expected to put in their carrier qualification flights and join the Fleet with the Fireball.

An important phase of this period concerned itself with the development of landing techniques suited to carrier operation with a tricycle landing gear. FR-1s returning to their carrier after a flight were considerably lighter due to fuel consumption. Consequently, when they touched down they had a tendency to bounce, then hook a wire with the resulting pull from the wire jerking the nose down hard, damaging the nose wheel or nose wheel fork. The failure of this unit would result in the propeller hitting the deck and some additional damage to engine and airframe. In an attempt to find



FR-1 Fireballs of U.S. Navy Squadron VF-66 line up prior to taking off from NAAS Brown Field, California for the official West Coast unveiling of the new Ryan fighter on 26 September 1945. (Photo - 28-4627)

a way to overcome the bounce, Lt. D. M. "Whitey" Krueger and Lt. Crd. William McClendon, the Landing Signals Officer, spent many hours with Whitey doing the flying and Bill doing the waving. Together they finally worked out a technique that fairly well overcame the difficulty. The new technique called for a slight forward pressure on the stick just before touch down. This gave a nose down moment that prevented the bounce or kept it from being too severe. Summing it up, Whitey Krueger said, "This (technique) called for a fine touch on the part of the pilot and was just the opposite of what the pilots of the period were used to doing."

On the morning of 5 November 1945, the full squadron embarked on the USS Wake Island (CVE 65) for the first carrier operations of an entire operational squadron of FR-1s. During the subsequent cruise, the necessary six landings required for carrier qualification were made by 14 different pilots. On 6 November 1945, Ens. J. C. "Jake" West made history quite unintentionally. Shortly after taking off he lost power on his forward engine. He succeeded, however, in starting the jet engine and returned to the carrier immediately. On jet power alone he made the first successful landing of a "jet-powered aircraft" on an aircraft carrier. Since the FR-1 was not a pure jet it did not receive the official credit for this honor, and the title went to a Vampire of the British Fleet Air Arm which made a successful landing on HMS Ocean, 3 December 1945. First official U.S. Navy jet to make a carrier landing was the Douglas FD-1 that touched down on the USS Roosevelt in July of 1946.

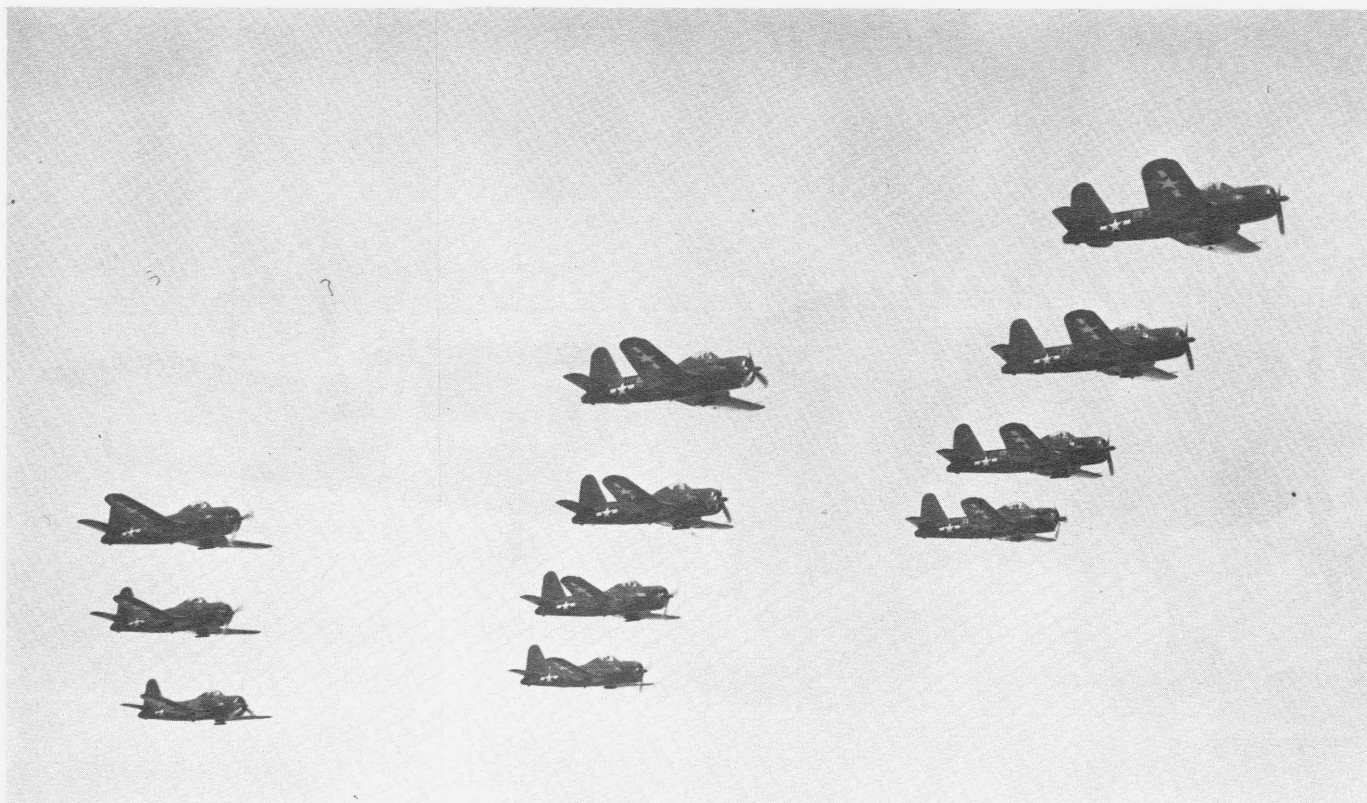
After this qualification cruise, the Squadron returned to San Diego and continued its training until it embarked on the USS Bairoko (CVE-115) on 4 March 1946, to carry out an operational evaluation of the FR-1. During the ensuing cruise structural defects developed in the nose wheel forks (following a week's carrier operations), causing the evaluation to be halted, and the Squadron returned to shore pending correction of the deficiencies. While this was in progress, faulty ail-

eron control quadrants required restrictions in flight, and later, evidence of partial structural failure in the wing sections grounded all aircraft pending further examination.

The difficulty with the nose wheel came from the same problem Whitey Krueger and Bill McClendon had striven to overcome. In designing the aircraft, the strength check of a nose gear for arrested landings assumed the main wheels on the deck with the airplane at stalling speed and in stalling attitude. By a series of dynamic calculations, taking into account inertial effects, the motion of the plane as it proceeded down the deck was determined. When it pitched over onto the nose gear at some point during the runout, the force on the gear could be approximated. (The method was set forth in BuAer Specification SS-16.) Unfortunately, this method assumed that the main gear was on the deck, but in practice this was not always the case, resulting in higher loads than the nose gear was designed to meet.

From a series of static tests on the nose gear and after a sifting of the results of carrier landings made by the FR-1, it was determined that the actual load on the nose wheel gear was approximately 100% over the calculated load during a free flight engagement and 50% higher during a bounce landing. The load increase during a free flight engagement was from an estimated 20,000-lbs to something on the order of 40,000-lbs. The hook was below the center of gravity, and if the FR-1 caught a wire before it touched down or after a bounce, the nose was pulled down sharply and the nose fork would give way. The failures led to the use of a steel nose wheel fork which could absorb the increased loads met in hard landings.

Regarding the partial wing structural failures, and a reputation the FR-1 had for weak wings, Mr. W. T. Immenschuh has made the following comment: "The wing on the FR-1 was one of the first laminar flow airfoils to be used. To be effective it required a high degree of aerodynamic smoothness. We therefore adopted a design policy of countersinking the rivets



Eleven Fireballs in flight on 26 September 1945 are: B-7, B-3, B-2 and B-1, top to bottom in first row; B-8 B-22, B-24 and B-10, in the middle row; and B-4, B-5 and B-6, in the last row. (Photo - Ryan 28-4598)

and then grinding the heads smooth. Under high stresses and structural deflection these rivets would slip (as was experienced in dive testing and Dean Lake's crash) and the joint would lose strength. The allowable load factor of 7.5 G was (consequently) reduced to 5 G for squadron aircraft. However, many Navy pilots in those days did not understand these relationships very well and because the airplane was so maneuverable, they often exceeded the limits. Hence, the reputation for so-called weak wings."

The Fireball's wings were soon to play a tragic part in the life of VF-41. On 3 June 1946, the Squadron flew north to Los Angeles to participate in an air show. When the show was completed, the Fireballs flew back to San Diego behind their Skipper, John F. Gray. Without warning the wing on Gray's airplane collapsed and the stricken bird lurched into the wing plane flown by Jake West. Both aircraft went down and neither pilot escaped. Apparently, the wing on the Skipper's airplane had been damaged or weakened during the air show causing it to fail on the return flight.

Following Gray's death Bill Elliott assumed command of the Firebirds, and command later passed to J. P. Conn and finally to Guy Anderson before the aircraft was taken out of service. Another accident (of about this period), took the life of Rudy Kreiger. Rudy was engaged in gunnery practice and was firing at a towed sleeve target when, in a pass, he came too close and hit the target tow bar. Apparently he was killed outright or rendered unconscious when the bar hit his canopy, for the airplane never faltered in its dive until it hit the surface of the ocean.

VF-41 was redesignated VF-1E on 15 November 1946, and by the end of February 1947 the difficulties which had been experienced on board the USS Bairoke had been rectified. VF-1E and its Fireballs were then scheduled for new carrier qualification trials on the USS Badoeng Strait (CVE-116) which departed North Island, California at 0700 hours on 3 March 1947. The FR-1s were land based on North Island and flew out to the carrier each

day with the first contingent going out on the 4th. This contingent consisted of four FR-1s, and they arrived over the ship at approximately 1020 hours and immediately began landing operations.

The first FR-1 to make its approach was piloted by Lt. Parker, and was Number B-2. He made an excellent, very smoothly executed approach and touchdown, catching the number 1 wire for a perfect landing. Cdr. Anderson followed in Number BS-101, came in a bit high on his approach but made a good landing catching the number 5 arresting wire.

The third airplane to approach the carrier was BS-106 (BUNO 39681). Its approach was high also but the pilot was given the cut sign and appeared to be in a good landing condition when, approximately over number 2 wire, he suddenly applied power and attempted to fly out. The airplane hit the barrier while about four feet off the deck, pitched to the left and went over the side about 30 feet forward of the barrier. As it went over, the airplane somersaulted and hit the water upside down but did not break-up. It sank almost immediately, but the pilot came to the surface before the aft end of the carrier passed the point of sinking. He was picked up by an escorting destroyer uninjured and apparently none the worse from the experience.

The landing officer, Lt. Cdr. McClendon, felt that the pilot was at fault for the mishap since he did not take the cut as directed. This was concurred in by the Admiral and Flight Officer, who had witnessed the accident. Excluding this incident, a total of 12 landings were made on this day.

Operations resumed on the following day, 5 March, with landing number 13 being made by BS-108. It was characterized by a very marked nose wheel landing while engaging the number 3 wire. BS-113 was next and also made a very hard landing. Then BS-114 came in, flew over the first eight wires and just managed to hook the last wire, number 9. It hit the barrier wires, the propeller and leading edge of the cowl were marked by the cable, but the plane was able to be flown back to the



A Ryan Fireball, BUJO 39703, of VF-41 as it appeared at Oakland, California on 12 October 1946. The colorful markings of B-17 (white tail and wing tips with yellow bands and number) were one of a kind. (Photo - Larkins)

beach. The following twenty-five landings were more or less normal (five were on the rough side with the deck pitching) but the day's last three merit mention.

BS-118 caught the number 3 wire in making a good landing and had completed about 80% of the run-out on this wire when the hook released the wire and the plane continued forward but then caught the number 7 wire. No apparent damage was noticed. The next FR-1 caught the number 7 wire but the barrier was not dropped in time. One propeller blade was marked and cables lay over the shimmy dampers on the nose gear when it came to a halt. Damage was minor and the airplane was flown back to the base. The final landing for the day was very hard on the nose wheel, and the airplane bounced about 12 inches off the deck.

During the third day, 6 March, landings 43 through 70 were made. Nine of these were hard landings, and two deserve mention. Landing number 44 was made in BS-105 by the same pilot who went over the side on the 4th, and it extended his string of bad luck. He hooked wire number 2 and the nose wheel hit the deck while the main gear was still 12 inches off it. One spoke and the rim on the nose wheel cracked at the point of impact, and the right main gear axle bent, allowing the wheel rim to rub on the strut. The aircraft, however, was still able to fly back to the beach. One observer stated the pilot, no doubt recalling his accident of the first day, had no intention of repeating it, and he practically dived into the deck, hitting it square in the middle. Later, BS-115 made a good landing but during unhooking of the arresting wire the plane fell back on its tail and damaged the tail cone skin very badly around the bumper. The plane had started to swing around on the deck and the handling crew jumped away and dropped the tail. (When the forward fuel tank of the FR-1 was empty, the aircraft had a tendency to fall back on its tail rather easily.) In this case, a bad diagonal wrinkle occurred on the right hand side of the tail cone.

During trials aboard the Badoeng Strait, 70 carrier landings were made, 8 pilots completed carrier qualifi-

cations in the FR-1, one airplane was lost and four were slightly damaged. W. T. Immenschuh and Frank Pellegrine, representing Ryan during the trials, concluded that continued FR-1 operation would result in the following difficulties: 1) Very hard landings would cause the spokes in the magnesium nose wheel to fail and the main gear to deflect and sometimes take a permanent set, thus causing the rim of the wheel to rub against the shock strut. 2) The tendency of the airplane to fall back on its tail after run-out would cause wrinkles in the skin of the cone around the bumper. 3) Deck handling would be criticized by Navy personnel because it required six extra men to handle the FR-1 in comparison with other fighter type aircraft.

On 25 March 1947, a Fireball was damaged when the gear folded. On 27 April the Squadron embarked on the Badoeng Strait for a brief period of anti-submarine exercises. They again put to sea on 21 June, this time on the USS Rendova (CVE-114) for six days of operations that were destined to be the last carrier operations for the Firebirds. As a result of a hard landing, during this tour, in which the aircraft broke in two, all Squadron airplanes were grounded and given a thorough check. When every aircraft showed signs of structural deterioration, all operationally assigned FR-1s were grounded until further notice. By mid-July 1947 the decision to withdraw them from Fleet service had been made and carried out. Thus ended the operational saga of the Fireball, an airplane that due to wartime secrecy and post-war indifference has never been given its proper place in history.

What may have been the last flight of an FR-1 was logged by Commander H. C. Gustafson and is best described in his own words:

"According to my flight log, FR-1, BUJO 39676, the last FR-1 to fly, was assigned to VRF-32 in San Diego during March 1948. It was flown to El Paso, Texas enroute to N.A.T.T.C. in Memphis, by either Lt. Art La Pointe or Lt. Art Tye. The plane was downed for lack of a prop governor and numerous

oil leaks in El Paso. On 21 April 1948 I arrived in El Paso to complete delivery of the aircraft to Memphis. After an extremely hairy cross-country flight via Big Spring, Texas and Dallas the aircraft was delivered to N.A.T.T.C., Memphis, a very tired bird. Enroute trouble was experienced with every system in the bird. We arrived in Memphis sans fluids - period."

Another FR-1 had been delivered to the same station in February 1948, and both of these were eventually turned over to Mississippi State University. Others were assigned to mechanic training schools or turned over to aeronautical schools or air stations to serve as historical mementos. Two were donated to Lewis Institute at Lockport, Illinois but were eventually sold for scrap. One had been preserved for the National Air Collection by the Smithsonian Institute and is now in storage for this organization.

Although many of the Firebirds left the Navy at the end of the war, a number remained in the service. Today these include Commander Duane M. Krueger, the CIC Officer of the USS Ranger (CVA-61); Captain William Elliott, now on CINCPACFLT staff in Hawaii; Commander Dixie Mays is stationed at the Naval Aviation Safety Center at Norfolk, Virginia; Commander Jim Swope is now stationed in Washington; Commander Tom Sedaker is on COMNAVAIRPAC staff at North Island, California; Commander Dick Cyr now commands Carrier Air Group 19; Captain Guy Anderson, the fourth CO, is stationed in Washington; Lt. Commander Jerry Strayve is on the USS Ticonderoga (CV-14); and Lt. Commander Ken Strecker is a member of VF-142 at NAS Miramar, California.

Swope, Sedaker, Cyr, Anderson, Strayve and Strecker joined the Squadron after it was changed over to VF-41 and were not members of the original VF-66. Rufe Henderson left the Navy, was recalled during Korea, but is now out again. Robinson is now flying for a midwest airline, and most of the other Firebirds are leading happy, successful lives as civilians, but no doubt miss their old Squadron.

FR-1 ALLOCATIONS*

Bureau Number	Type	Activity and Remarks
48232	XFR-1	Crashed
48233	XFR-1	NAMC
48234	XFR-1	Crashed
39647	FR-1	Crashed
39648		Patuxent Armament
39649		Crashed
39650		Ames Lab Wind Tunnel Tests
39651		Patuxent Service Test
39652		ComFairWest VF-66
39653		Crashed
39654		ComFairWest VF-66
39655		Ryan Aileron & Jet Tests
39656		Ryan & Ames 4° Inc. Dihedral
39657		Ames Lab Rudder Tests
39658		Patuxent Flight Test
39659		ComFairWest VF-66
39660		Ryan & Ames 2° Inc. Dihedral
39661		Ryan Became XF2R-1
39662		Ryan Demonstration
39663		NAMC Catapult Tests
39664		Patuxent Radio & Electrical
39665		Ryan 8" Extended Fuselage FR-4
39666		Patuxent Flight Test (all fixes)
39667		Patuxent Armament Tests
39668		Ryan Engine Cooling
39669		Spare
39670		ComFairWest VF-66
39671		NATTC Memphis
39672		ComFairWest VF-66
39673		ComFairWest VF-66
39674		Patuxent Service Test

39675	FR-1	ComFairWest VF-66
39676		NAMC Static Test--To Memphis
39677-688		CFWC VF-66, 39681 Crashed
39689-690		AAF (Not delivered)
39691-706		ComFairWest VF-66
39707		Ryan 8" Extended Fuselage
39708		Inyokern Rocket Tests
39709-710		NATTC Memphis
39711		Patuxent Service Test
39712-739		ComFairWest VF-66
39740		Ryan 8" Extended Fuselage
39741-746		CNAOTC

*This is taken from a listing of Proposed Allocation of FR-1 Airplanes, dated 21 July 1945. BUNO's 39713 through 39746 were not built. BUNO's 39713 & 39714 were to be XF2R-2s. BUNO 39707 is now in the Smithsonian Collection.

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FIGHTING 66, Unit History.

"Aeronautical Engineering Conference Technical Papers", Postgraduate School, U.S. Naval Academy Field Trip 13-14 September 1946 at Ryan Aeronautical Company.

"Preliminary Pilot's Flight Operating Instructions For The FR-1 Airplane", Ryan Report 28-11.3, 26 January 1946 by Ryan Aeronautical Company.

"Trip Aboard Carrier For Qualification Trials of Pilots in FR-1 Airplanes", Report by W. T. Immenschuh, 11 March 1947.

"Ryan FR-1 Fireball Navy Fighter Specifications", Ryan publicity release written by W. P. Brotherton.

"Detail Specifications for Model FR-1 Airplanes (Single Seat Monoplane)", 26 July 1943. NAVAER SD-330-1. Revised Final Corrected 26 Nov '45, Contract NOa(s) 1322. "Detail Specifications for XF2R-1 Model Airplane (Single Seat Monoplane)", NAVAER SD-339. Contract NOa(s) 1322 (MCR-56).

ABOUT THE AUTHOR: Ernie McDowell was born in Chicago during 1921 and still lives in the Windy City. An Uncle, Roy Brownfield, was in the Air Service in WW I and he continued to do a little flying at Checkerboard Field near Chicago. There, Ernie's interest in flying started at about age 6. He recalls Lindbergh, his visit after the flight, and the various visits to Chicago of the Zeppelins, the flight of Balboa and the air races at Glenview.

In 1942 he entered Cadet Training, being classified as a Bombardier. During advanced training at Midland, Texas, Ernie suffered a punctured ear drum which terminated his training and later took him out of the AAF. Following the war, he attended the University of Illinois, studied civil engineering but switched to Traffic Management and is now Traffic Manager of the Cenco Instruments Corporation. He is married, collects aviation data, builds models, takes photos and writes.

During the Rose Parade held in Pasadena, California on 1 January 1946, Ernie was much taken by a float that consisted of a small replica of the Fireball done in flowers. Upon joining the A.A.H.S. and after listening to George Hardie, he decided that he should do an article for the JOURNAL and selected the Fireball, picking this subject, "...since so little had been done on it and it certainly seemed to deserve a place in history."