Menasco Aircraft Engines and Their Air Racing Heritage

Part 2

by Larry M. Rinek

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Air Racing Heritage

Al Menasco's air racing heritage, more than any other achievement, put his engines "on the map." From 1930 to 1937, Menasco engines won three times as many air races in US and foreign closed course competition as all other brands combined.[52] They totally dominated their size classes (discouraging the entry of rivals) and even scored key victories against much larger engines (e.g., 1,200 hp 1,830 cu. in. Pratt & Whitney radials) in Thompson Trophy national air races. The Menasco racing engines were major technical achievements, and only certain engineering obstacles forestalled even better results.

Al Menasco had been interested in auto (and also motorcycle) racing from an early age. One of the benefits of being chief executive of an aircraft engine producer was the opportunity to associate with the exciting air racing community. Thus, Menasco was personally inclined to help racers. Furthermore, involvement in winning races was also good public relations for the company, and demanding race projects would help Menasco to upgrade his designs. Menasco became lifelong friends with racing aircraft builders, race pilots, and race promoters (e.g., Cliff Henderson, Menasco's high school pal who ran the national air races for 12 years).

One of the myths propagated by Al Menasco was the notion that racers ran "stock" Menasco engines. For example, the following (facetious) statement appeared in Menasco's 1938 catalog: "Although the consistent racing champion, Menasco does not build special racing engines." The historical data strongly suggest otherwise, however. A prominent racer, Art Chester, was hired in 1936 as Menasco's chief experimental engineer and proceeded to build in-house racing C6S-4 engines with Menasco's assistance, parts, and approval.[53,54] Although many racers did run stock engines, the better known Thompson and Greve Trophy racers (with Menasco engines) extensively modified their engines, usually (but not always) with factory assistance. Various "adaptations" for racing (such as custom camshafts, magnesium cases, and forged steel cylinders) were conceded in documents found in company archives (in Ft. Worth, Texas),[55] as well as other air racing sources.[56]

Running up the uncowled Menasco in the Keith Rider R-5 (David Ostrowski)

The basic key to Menasco's racing edge was low frontal area (about 2.5 sq. ft., and less width than a pilot's shoulders), which permitted use of small, light, and very slim racers of low drag that overcame the horsepower advantages of the larger radials. The radials, however, were always easier to cool and could race with less stress. The inline, buried in a cowling, has an inherent cooling problem that is not necessarily restricted to the back "jugs" (cylinder No. l , in the front, could run the hottest). Menasco handbook specifications called for an offset air intake of a certain size, to encourage flow across the cylinder barrels to an exit (such as louvers) with a larger (at least 40% greater) area to allow for hot air expansion. Another air intake hole in the cowling allowed a straight shot at the valve gear and the top of the cylinder heads; this design was used in Art Chester's "Jeep" race plane as well as many others. Sheet metal baffling was mandatory to direct air properly around the cylinders. The Menasco inline, a dry sump engine, used a separate oil tank that rejected some heat, but surprisingly few racers were willing to put separate oil coolers in the air stream because they did not want to incur the drag penalty." Despite these useful efforts to improve cooling, as racing stress and manifold pressures rose, the heat flux in the cylinder heads was so high that most Menasco racers at full throttle sooner or later overheated to a destructive detonation condition, and pilots were forced to race mostly at part throttle. Only one or two Menasco racing teams (including Schoenfeldt's) managed to overcome another special heat problem developed by Menasco engines: inadequate cooling air to the dual magnetos at the rear of the engine eventually invited power-robbing misfiring that also reduced the speeds that could be attained.[58] These cooling maladies prevented Menasco engines from achieving even greater racing glory.

The Menasco presence was extensive in numerous air races across the United Stated and overseas. To illustrate Menasco's successes, this article focuses on results in the US National Air Races (NAR). The first Menasco engine appeared in the NAR in Chicago in 1930. The 1931 races were the occasion of the first Menasco victories with the new Rider R-1 (with C6S engine), "San Francisco I," as well as the Gee Bee Sportster model D (with C4 engine).[59] Table 2 summarizes Menasco engines' results for various famous racers in the 1930s. Menasco's all-time best showing was in the 1937 Cleveland NAR, where both the unlimited Thompson Trophy and the Louis Greve Trophy (for engines under 550 cu. in.) were won by pilot Rudy Kling in the Folkerts SK-3 "Jupiter" powered by a modified C6S-4. A witness to this great Thompson victory (interviewed by the author) saw Al Menasco actually jumping up and down for joy after officials waved the checkered flag for Kling.[60]

After the race, a local publication reported: "Kling's engine was a stock model and had not been altered or changed by him after it had been removed from the delivery crate."[61] However, the engine likely received factory "upgrades," such as a supercharger boost, before it was mounted in the crate. Typical racer modifications of Menasco engines included:

- Boosted manifold pressure (e.g., an increase in the blower drive ratio, which was feasible with higher octane racing fuels). The 1938 and 1939 NARs featured plentiful 100 octane aviation gas.
- Racing cams of higher lift and longer duration with torque peaks favoring the higher speed (3,000 or more RPM) race environment.
- Special pistons with thin, low-friction rings.

Art Chester's "Jeep" in 1936 (David Ostrowski)

• Special cylinder heads. (For the "Goon," Art Chester actually flipped exhaust ports and intake ports to opposite sides of the normally configured C6S-4.)

• Special valves. (Some heads, such as those in the Rider R-4 "Schoenfeldt Firecracker" flown by Tony LeVier, received Pratt & Whitney-type Thompson sodium-cooled exhaust valves.)

• Larger Stromberg carburetors.

• Special crankshafts. (For example, in the "Goon," Art Chester used factory resources to produce an ultra-smooth, counterweighted racing crank with special splines and mounting for the Ratier two-position racing propeller.)

• Custom cylinder baffling.

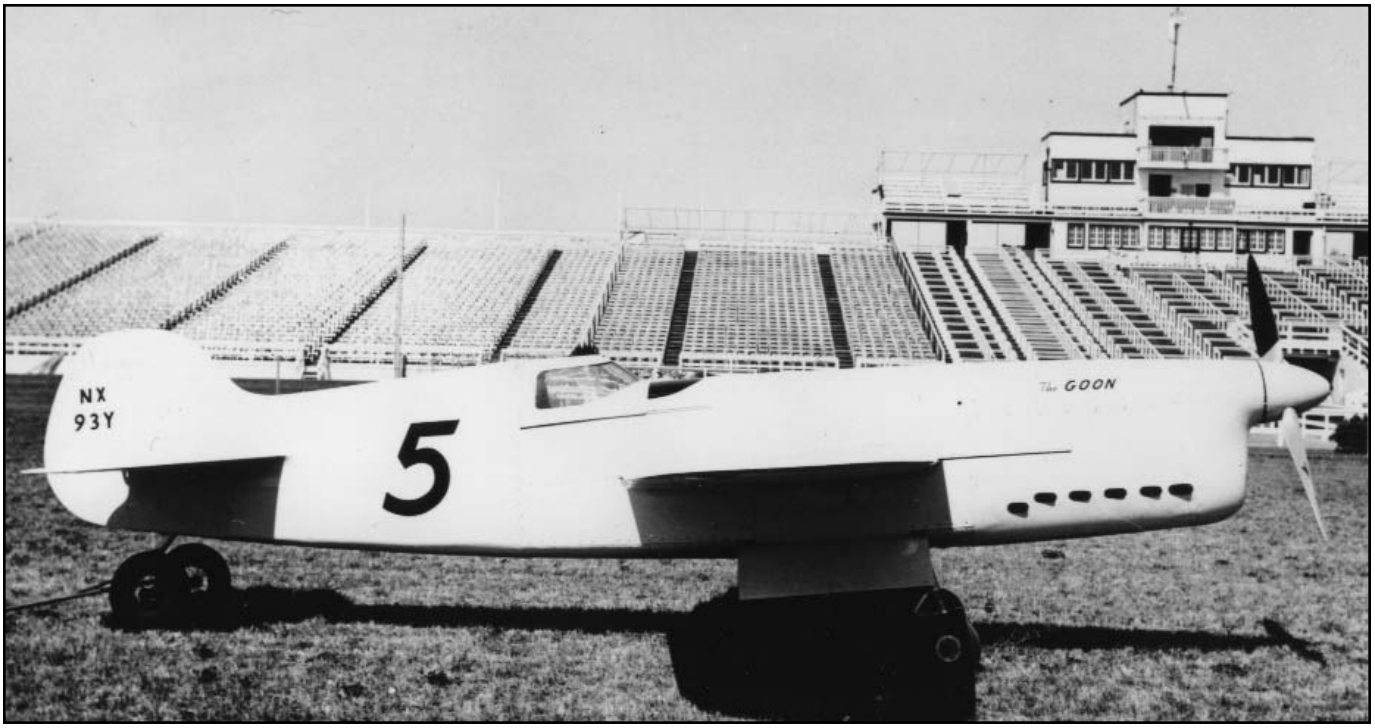
• Higher compression ratio (high-dome pistons).

With some of these modifications, the small C4S could deliver 220-230 hp and produce lap speeds up to 230-240 mph (263 mph on the straight-aways). The larger C6S-4s were usually modified to produce 350-400 hp. With that power, Menasco-engine racers could produce 300 mph laps.

Returning to the issue of special cylinder heads, the situation with Art Chester's "Goon" and its flipped ports deserves revisiting. Aero publications of the era first reported stories by journalists perhaps unfamiliar with engine technology, such as 180° rotation of cylinders and reverse rotation of the "Goon" prop.[62] Regrettably, these accounts were repeated in various modern historical publications.

My engineering analysis, in consultation with David Holcombe, curator of the Crawford Auto-Aviation museum ("Goon" exhibitor), tends to refute these claims, although Chester and his engine do not survive to provide a definitive answer. It is clear that intake and exhaust ports were switched by Chester to opposite sides of the stock position, as seen in photos of the "Goon." The likely reason was to better allow prop-wash to direct exhaust fumes away from the cockpit, as was the case in prior race engines from Menasco (C4S, B6S, C6S). The new twin cam arrangement *(two cams, but conventional push rod valve gear - Ed.)* of the C6S-4 facilitated this port switch and the factory also commonly performed this modification on the C6S-4 during the Unitwin development program.[66] Drawings of the engine suggest that port sizes and valve sizes were the same (helpful) but it was still mandatory to switch valves in each cylinder as the exhaust side used a different higher-temperature steel alloy. Thus, with cam, manifold, and valve changes, ports could he flipped with no change in prop rotation.

The notion (widely reported) that barrels were rotated 180° in Chester's C6S-4 in order to flip the ports, or change rotation, needs correction. Turning around barrels does not change engine rotation—pistons don't care which side has intake or exhaust, or which way the gases flow. This barrel rotation tactic was not only unnecessary, but not possible either once you inspect the Menasco offset rocker box/pushrod layout from the underside view; after barrel rotation the pushrods would not line up properly with rockers.



Art Chester's "Goon" in 1938 (David Ostrowski)

Table 2. Prominent Menasco-Engine Racers: National Air Race Highlights of 1930s

Aircraft Model	Menasco Model	Pilots	Year	<---------- Best Results ----------> Thompson	Greve	Other
Brown B-2 "Miss Los Angeles"	C6S	Roy Minor	1934	2nd		1st in two 550 cu in races, 4th in a 1,000 cu in race
Brown B-2 "Miss Los Angeles"	C6S	Marion McKeen	1935	6th		2nd in one 550 cu in Greve race
Brown B-2 "Miss Los Angeles"	C6S	Marion McKeen	1936	5th		3rd in one 550 cu in race
Chester "Goon"	C6S-4	Art Chester	1938		2nd	
Chester "Goon"	C6S-4	Art Chester	1939	7th	1st	
Chester "Jeep"	C4S	Art Chester	1936		3rd	2nd in three 375 cu in races
Chester "Jeep"	C4S	Art Chester	1937			1st in consolation race, 3rd in two 397 cu in races
Chester Special	C4S	Art Chester	1932			1st in one 375 cu in race
Chester Special	C4S	Art Chester	1933			1st and four 4ths in 375 cu in races
Chester Special	C4S	Art Chester	1934	6th		2nd in four 375 cu in races, 3rd in two, 4th/5th in two more 550 cu in races
Chester Special	C4S	Art Chester	1935			1st in two 375 cu in races, 3rd and 4th in two 550 cu in races
Crosby C6R3 (or "CR-3")	C6S-4	Harry Crosby	1936	6th		
Crosby CR-4	C6S-4	Harry Crosby	1939	4th	3rd	
Folkerts SK-2	C4S	Harold Neumann	1936	4th	2nd	1st in two 375 cu in races, 2nd in Shell Dash 550 cu in race
Folkerts SK-3 "Jupiter"	C6S-4	Rudy Kling	1937	1st	1st	1 st in Greve qualifying race
Howard DGA-4 "Mike"	B6S	Harold Neumann	1934	4th	1st	1st in Shell Dash 550 cu. in race, 1st and 4th in two other 550 cu in races, 3rd in 1,000 cu in race
Howard DGA-4 "Mike"	B6S	Harold Neumann	1935	1st		
Howard DGA-4 "Mike"	B6S	Roy Minor	1933	3rd		1st in four 550 cu in races, 4th in unlimited Shell Dash, 2nd and 3rd in two 1,000 cu in races
Howard DGA-5 "Ike"	B6	William Ong	1932	7th		2nd in 685 cu in race
Howard DGA-5 "Ike"	B6	Ben Howard	1932			1st in 510 cu in and 685 cu in races, 2nd in Phillips Trophy race
Israel "Red Head"	C6S	Gordon Israel	1932			3rd in five 550 en. in. races, 5th in 1,000 cu in race
Miles & Atwood Special	C4S	Lee Miles	1933			1st in two and 3rd in two 375 cu in races, 4th in one and 5th in three 550 cu in races
Miles & Atwood Special	C4S	Lee Miles	1934	8th	1st	1st in five 375 cu in races, 1st, 2nd, 3rd, and 4th in four 550 cu in races
Rider R-1 “San Francisco I”	C6S	Ray Moore	1931			1st in 800 cu in race, 2nd in 1,000 cu in race
Rider R-1 “San Francisco I”	C6S	Ray Moore	1932			1st in Phillips Trophy race, 7th in Shell Dash, 4th in one 1,000 cu in race
Rider R-1 “San Francisco I”	C6S	Ray Moore	1933			1st in one, 2nd in four 550 cu in races, 4th in one 1,000 cu in race, 5th in unlimited Shell Dash
Rider R-1 “San Francisco I”	C6S	Roger Don Rae	1934	5th		2nd in two, 3rd in one 550 cu in races, 5th in one 1,000 cu in race
Rider R- I “San Francisco I”	C6S	Roger Don Rae	1935	3rd		2nd in one Greve race, 3rd in another (three races for Greve)
Rider R-1 “San Francisco I”	C6S	Rudy Kling	1936	4th		2nd and 4th in 550 cu in races
Rider R-2	C4S	George Hague	1933	4th		One 1st, three 2nd, one 4th in 375 cu in, four 4th, one 3rd, one 5th in 550 cu in races, 3rd in 1,000 cu in race
Rider R-4	B6S	Roger Don Rae	1936	3rd		1st in Shell Dash-550 cu in
Rider R-4	C6S-4	Gus Gotch	1937	7th	3rd	
Rider R-4 "Schoenfeldt Firecracker"	C6S-4	Tony LeVier	1938	1st		
Rider R-4 "Schoenfeldt Firecracker"	C6S-4	Tony LeVier	1939	2nd	2nd	
Rider R-6	C6S-4	Joe Jacobson	1938	6th	3rd	
Wittman "Chief Oshkosh"	C4S	Steve Wittman	1937	2nd		1st in two 397 cu in races

Source: Schmid, S.H. and Weaver, Truman C., *The Golden Age of Air Racing*, 1991, EAA Aviation Foundation, Oshkosh, Wisconsin

As to the reported stories that Chester initially reversed engine rotation and then quickly reversed it back, Holcombe and I agree that these are unlikely to be true. Reportedly, Chester prepared to get a Ratier two-position racing prop with reverse (European clockwise) rotation, but was "surprisingly" delivered a US counterclockwise (CCW) rotation prop. My view is that a normal CCW prop was ordered, delivered, raced, and expected all along by Chester. The main reason is that reversing rotation of a supercharged Menasco is rather difficult, and therefore unlikely to be attempted-even by a sharp mechanic like Art Chester. Yes, a cam and ignition timing change usually enables reverse rotation, except that with the C6S-4, the supercharger would then become unacceptably inefficient.

[It should be noted that a centrifugal compressor can rotate in either direction and still pump. However, reverse rotation would cause a considerable drop in efficiency if the impeller incorporates rotating inlet guide vanes, a.k.a. inducer. If the impeller did not have rotating inlet guide vanes/inducer then the impeller efficiently would not be affected. This in fact was the case with the Menasco, it had straight impeller vanes and no rotating inlet guide vanes/inducer. Another design aspect is the volute housing and diffuser vanes, if fitted. They too are optimized for one direction, however, the supercharger would still pump albeit at much reduced flow. Pratt & Whitney learned this lesson when developing the R-2800-32W supercharger. The -32W auxiliary stage supercharger consisted of two laterally mounted "side wheel" impellers driven on the same shaft. The two impellers needed to be mirror images but in a design error they were both made the same. Initially, P&W engineers could not figure out why one side was pumping as designed but the other side was woefully down in pumping efficiency. Of course, it didn't take long to figure out that one impeller was running in the "wrong" direction. -Ed.]

For reverse rotation a unique mirror-image impeller would have to be designed and hand machined, or, a totally revised gear train installed to enable original impeller rotation while the crank turned backwards; no evidence exists that such was done. Although Al Menasco was fairly accommodating with engine race modifications (especially ones done in-house) the blower mods were generally restricted to gear ratio changes (higher manifold pressures). The whole concept of reverse rotation is implausible.

One of the few competent independent Menasco race engine builders was Ed Winfield in Los Angeles (of Indianapolis 500 car racing fame); he worked for the Schoenfeldt team piloted by Tony LeVier. The Winfield-modified engine for LeVier was estimated to deliver over 500 hp at 3,500 rpm with 100 octane gas and 72 in. Hg manifold pressure. It achieved straight-away speeds up to 350-355 mph, as demonstrated in a secret test.[67]

Spectators at these air races testified to the unique sound, or "growl," emitted from these racing Menasco inline engines.[68] The engines were temperamental, yet highly entertaining to race fans.

When air races resumed after WW II, Menasco engines/parts were especially scarce. The faster military-surplus engines developed during the war were superior in any case, boosting Thompson lap speeds by at least 100 mph.69 The advent of these engines marked the passing of an unforgettable era-the golden age of air racing with inline Menasco engines.

Bill Turner's Miles & Atwood Special Reproduction with C4 (Rinek Collection)

Readers interested in seeing original Menasco engines, and airframes still containing these engines, are encouraged to visit some of the following US museums:

- National Air & Space Museum, Garber Facility, Suitland, MD (Lindbergh's B6S, B4 cutaway)
- Planes of Fame Museum, Chino, CA (Miles & Atwood replica w/ C4)
- San Diego Aerospace Museum, San Diego, CA (Ryan ST -A w/ C4, D4 cutaway, M-50)
- Hiller Museum, under construction in San Carlos, CA (Stearman-Hammond Y- IS w/ C4S)
- USAF Museum, Wright Patterson AFB, OH (Ryan PT 16, original prototype w/ C4)
- Crawford Auto-Aviation Museum, The Western Reserve Historical Society, Cleveland, OH (Art Chester's "Goon" racer with replacement unrestored C6S-4)
- Pima Air Museum, Tucson, AZ (original, unrestored C6S-4)
- EAA Museum, Oshkosh, WI (extremely rare C6S-5 on display, S/N 6200, plus restored Crosby 1939 vintage CR-4 racer that reportedly flew with this engine)
- California Antique Aircraft Museum, San Martin, CA (D4-87).

Furthermore, at airports across the United States can be found flying antique Menasco engines, usually in restored Ryan ST airframes, occasionally in originals or replicas of other 1930s classics.

Concluding Remarks

Al Menasco proved to be a gifted engine developer and engineer, and a pioneer in American aviation. Although it was well known for its line of inverted, inline, air-cooled engines (primarily as a result of racing victories in the 1930s), Menasco's engine company never showed a net profit until it made the transition to manufacture of aircraft landing gear.[70] Fundamentally, however, engines were Al's first love: "My interest in engines was always paramount to all else."[71]

Long active in aviation (Institute of the Aeronautical Sciences, Quiet Birdmen, Pacific Aviation Club) and professional societies (Society of Automotive Engineers),[72] Al Menasco made broader contributions to the community. After his departure from Menasco Manufacturing in 1938, he ran Ford auto dealerships, and served in the Army Air Force as a procurement officer in WW II.[73] In the 1950s, he became involved in grape growing/wine making in Northern California, invested in a tractor dealership, and reached the advanced age of 91 before expiring in November, 1988. In the 1980s, he was working on a small aero museum to showcase his mementos at his family's Napa Valley ranch, and he shared his thoughts with some journalists and historians. The air racing world will not forget the mark he made on our history.

References and Notes

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53. Huntington, Roger, *Thompson Trophy Racers*, 1989, Motorbooks International, Osceola, Wisconsin, p. 89.

54. Bodie, Warren, "Sky Kings," pt. II, *Wings*, October 1984, p. 49.

55. Menasco Mfg. Co., "Engine Schedules" of December 18, 1933, January 12, 1934, March 26, 1934, May 18, 1934 and so forth described special orders and build practices for racing customers.

56. Huntington, op. cit.

57. Art Chester's "Goon" had a skin-type oil cooler on the underbody. LeVier's Rider R-4 also had a skin-type oil cooler.

58. Huntington, op. cit., p. 57.

59. "1931 National Air Race Results," *Aero Digest*, October 1931.

60. May 14, 1996 phone interview with Mr. Bill Turner, vintage race plane owner, who was at the 1937 NAR (with his father) in Cleveland.

61. *Lockheed Aircrafismen*, October 1937.

62. McLarren, Robert, "Aviation's Dare-Devil Scientists," *Model Airplane News*, December 1938.

63. Huntington, op. cit.. pp. 47, 90.

64. Bodie, Warren, "Sky Kings," pt. III, *Airpower*, November 1984, p. 42.

65. Caler, John W. and Underwood, John, *The Art Chester Story*, Caler Publications, 1967.

66. Archive photos of the Unitwin at the National Air & Space Museum clearly show reversed ports on two of three iterations (all exhausts to the outside, all exhausts to the inside, and staggered inside-outside exhaust with stock layout).

67. Huntington, op. cit., p. 92.

68. April 17, 1996 phone interview with Albert Sidney (Sid) Menasco Jr., who attended NARs in Cleveland and Los Angeles with his father. Sid stated that the outstanding "growl" of racing Menasco engines was recorded for sound effects by Hollywood Studios.

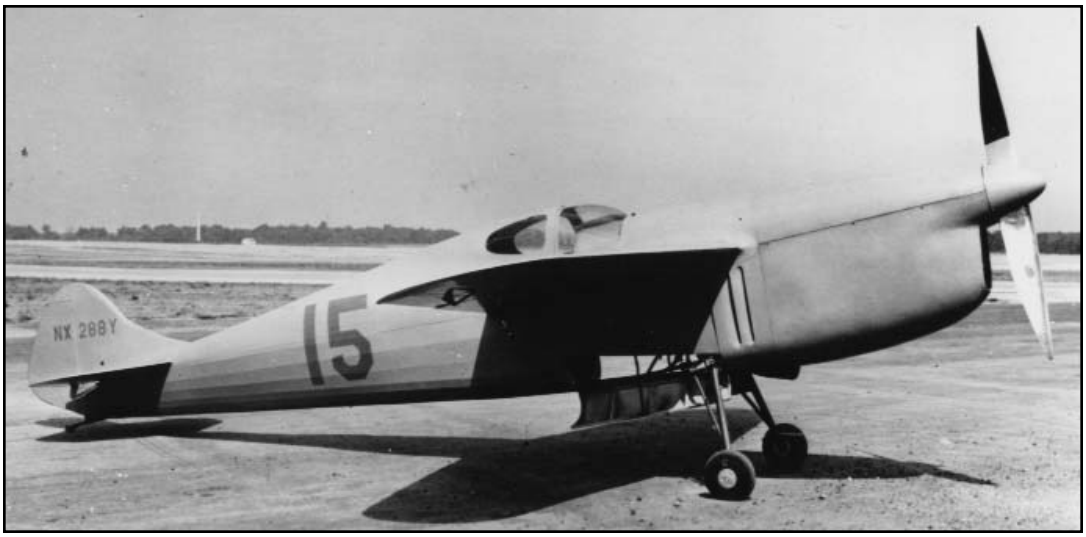
69. Huntington, op. cit., p. 187-188.

70. *Menasco Scout Newsletter*, 25th anniversary (19341959) souvenir edition, June 1959, p. 12 (excerpting Wall Street Journal, October 7, 1941).

71. "The Founder's Story," published speech by Al Menasco to Menasco Mfg. Co. California Division's Management Club, January 29, 1969, p. 4.

72. *Who's Who in Aviation*, 1942-1943, Ziff-Davis Publishing Co., Chicago-New York City, p. 288.

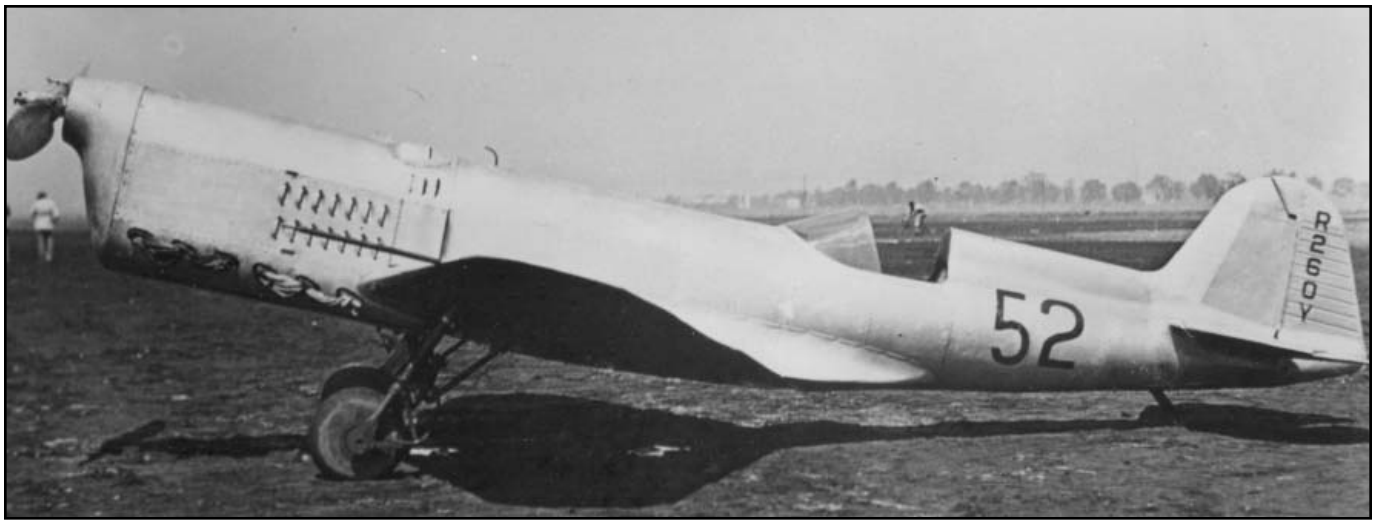
73. Army of the United States, Certificate of Service (3 August 1942 to 16 January 1945) issued to Major Albert S. Menasco, 0-912687, Air Corps. 16 January 1945.



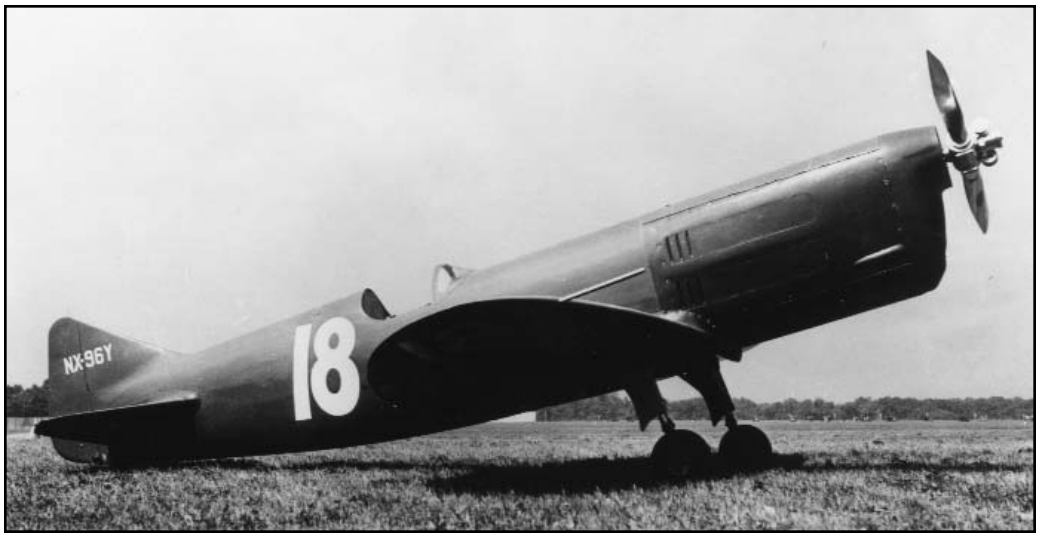
Folkerts SK4 (David Ostrowski)

The Keith Rider R-2 (David Ostrowski)

Howard's "Mike" (David Ostrowski)



Crosby C6R3 "CR-3" (David Ostrowski



The Keith Rider R-6 (David Ostrowski)

Howard's "Ike" (David Ostrowski)