# Changes in Recent Models of Wright "Whirlwind" Engines

SINCE the process of refinement from one model to another has been gradual and confined to various details of the engine, it is interesting to consider these changes as related to the more recent and widely known Wright "Whirlwind" engines.

**J-5C TO J-5CA** The changes between these models are of very minor nature. Fabric covered rubber ignition wire is used and the two crankshaft roller bearings are replaced with molybdenum steel ball bearings.

**J-5 TO J-5C** In this change the piston design is altered to permit the use of a permanent mold in casting and at the same time the compression ratio was altered to permit the use of a wider range of commercial aviation gasoline. In addition, the priming system on the Model J-5C now directs the raw fuel into the intake passages in the crankcase, thus eliminating the danger of washing the lubricant from the cylinder walls.

**J-4B TO J-5** This change in models marks the most important step which has been made in the "Whirlwind" series. It brings a degree of reliability and durability hitherto unknown, and a measure of fuel and maintenance economy unequalled by its predecessors.

The Model J-5 crankcase is essentially the same as on preceding models, although it is not interchangeable with any of them. The outstanding improvement is again in the cylinder construction and the valve gear has been entirely altered with a view to greater economy in maintenance.

The new cylinder is built in two parts; first, the cylinder barrel, with integral steel cooling fins machined out of the barrel forging; second, the cast aluminum alloy cylinder head, both screwed and shrunk onto the top of the barrel. The integral barrel-cooling fins permit direct heat transfer to the air, without the necessity of passing through the steel sleeve and aluminum cylinder barrel of the former models. The combustion chamber in the cylinder head is hemispherical in form and the inlet and exhaust valves are set at an agle of 70° with their heads flush in the combustion chamber. The exhaust valve is of the salt-cooled type which completely eliminates overheating. This design permits larger valves, with increased lift; more direct and larger intake and exhaust ports, with consequent improvement in the full throttle volumetric efficiency; and increased area of fins around the valve ports and cylinder head, to more effectively cool the cylinder. This cylinder and cylinder head construction is largely responsible for the improved fuel economy of the Model J-5, which on a fifty-hour full throttle endurance test averaged .458#/hp/hr with an output of 216 H.P. at 1827 R.P.M. It is doubtful if any engine in the world, either water cooled or air cooled, has been able to better this fuel economy during such a test.

The valve gear is enclosed, thus preventing both entrance of dust, dirt, and abrasives to the rapidly reciprocating parts, and blowing away of the lubricants from the bearing surfaces. The rocker arm has been generously increased in size and has been provided with improved bearings and lubrication. The rocker arm roller has been enlarged and is made of high heat resisting alloy steel which effectively eliminates rapid wear at this point. The valve clearance adjustment has been moved from the push rod, as on previous models, and is now incorporated in the rocker arm itself where micrometer divisions provide an easy and convenient means of adjustment without the use of feelers. The push rod ball end fits into an easily replaceable socket made of ball bearing steel; this socket in turn is housed in an adjusting seat screwed into the rocker arm end. The adjustment is locked in place by a suitable clamping screw on the end of the rocker arm. The push rods are made of nickel steel tubing and are provided with ball ends also of ball bearing steel. These ball ends, and their sockets in the rocker arm, are twice the area of those on the Model J-4B, giving an ample increase in contact area. This increased area, and improved material, results in a much greater life with remarkable freedom from frequent adjustment and lubrication.

The Model J-5 has also been provided with a new type of carburetor which incorporates in a single unit, three barrels supplied by a common float chamber, each barrel communicating to three cylinders through a separate manifold. This arrangement results in improved distribution and has its effect on the lower fuel consumption of the engine. The average "best setting" full throttle fuel consumption of a large number of production engines varies from 0.49 to 0.51#/hp/hr.

**J-4A TO J-4B** Only one change of any nature was made in this step. This also involved the cast aluminum cylinder barrel and cylinder head construction. In order to increase the cooling efficiency of the cylinder head the inlet port was carried straight back from the inlet valve, leaving space for cooling fins between the valves,

and the intake manifold was offset to meet it. In addition, the spark plug formerly on the cylinder head was moved to a position on the front of the cylinder, thus permitting an unimpeded air flow across the center of the cylinder head. This improved cylinder head cooling, together with a slightly increased number of fins on the cylinder barrel, resulted in an engine of outstanding merit. It was the Model J-4B engine which was so widely used in commercial operations during 1926 and which during this year established a record of 1,750,000 miles flying with only three forced landings due to mechanical failures in the engines.

**J-4 TO J-4A** Duralumin was substituted for steel in the front propeller hub plate, cowling supports were added to the crankcase, Scintilla magnetos were adopted, and a change was made in the magneto coupling giving a positive gear connection to this important unit. The only change aiming at greater strength and durability was to use a wrist pin of larger diameter which completely eliminated all pin failures. The most important change, however, was in the aluminum cylinder barrel. In the former model the cooling fins were placed close together, the lower fins being finish machined. In the latter model the fins were spaced wider apart and cast thin so as to eliminate the machining operation.

**ENDURANCE AND OVERLOAD TESTS** The endurance tests on the Model J-5 engine have been exceptionally severe. Three fifty-hour endurance tests have been run on this engine, in addition to approximately 100 hours of miscellaneous calibration and fuel consumption tests. The first fifty-hour endurance test was run at 1971 R.P.M. at full throttle, giving an average mean effective pressure of 121 pounds per square inch. The average power developed during this test was 238 H.P. and the fuel consumption was .508#/hp/hr. The second fifty-hour endurance test was run at 1827 R.P.M. at full throttle and showed an average power of 216 H.P., with a fuel consumption averaging .458#/hp/hr. and a mean effective pressure of 119 pounds per square inch. The third fifty-hour endurance test was made in an effort to determine the overload durability of the engine. To this end an external supercharger was provided, arranged so as to force air into the carburetor. No other change was made in the engine itself. In spite of the fact that this test was conducted during the hottest part of the summer with the air temperature averaging 150°F., at the point of entrance to the carburetor, the engine ran fifty hours without difficulty, averaging 295 H.P. at 2150 R.P.M., and with a fuel consumption of .510#/hp/hr. While this remarkable test has no immediate practical value to commercial aeronautics, it does indicate the extreme durability and strength built into the engine and gives assurance to its users that under normal conditions the life of the engine is exceptionally long.

**GENERAL** The improvements incorporated in the Model J-5 series make this engine peculiarly well suited to commercial service, where profits are dependent on continued successful operation without forced landings, and where the operating expense is affected by low fuel consumption and a minimum amount of labor in engine maintenance and in overhaul. With the enclosed valve gear of increased area, it is expected that the valve clearances will not require readjustment for periods of from twenty-five to fifty hours, and that the rocker arm bearings will need lubrication only each fifteen hours. This feature alone results in a large decrease in maintenance costs, since all engines with exposed valve gear require complete readjustment and lubrication of the valve gear approximately each five hours. With the valve gear properly adjusted and set, this maintenance expense is eliminated except for infrequent periods.

**PRODUCTION ENGINE #7239**

***World's Endurance Record:***

***51 Hrs. 11 Mins. 20 Secs.***

The new World's Endurance Record was established by a standard Wright "Whirlwind" engine taken from regular production. No special attention was given the engine. Previous to the endurance flight the engine had participated in the National Air Races at Philadelphia; had seen seventy-five hours' service on one of the Contract Air Mail Routes; had been used for various fuel and oil tests at full throttle; and had been used on many cross-country flights to Eastern points. At 166 hours 38 minutes the engine was top-overhauled. When the Record Flight started, the engine had had 179 hours 53 minutes service.

During the Record Flight, 385 gallons of gasoline and 4.93 gallons of oil were used, an hourly average of 7½ gallons of gasoline and less than one pint of oil.