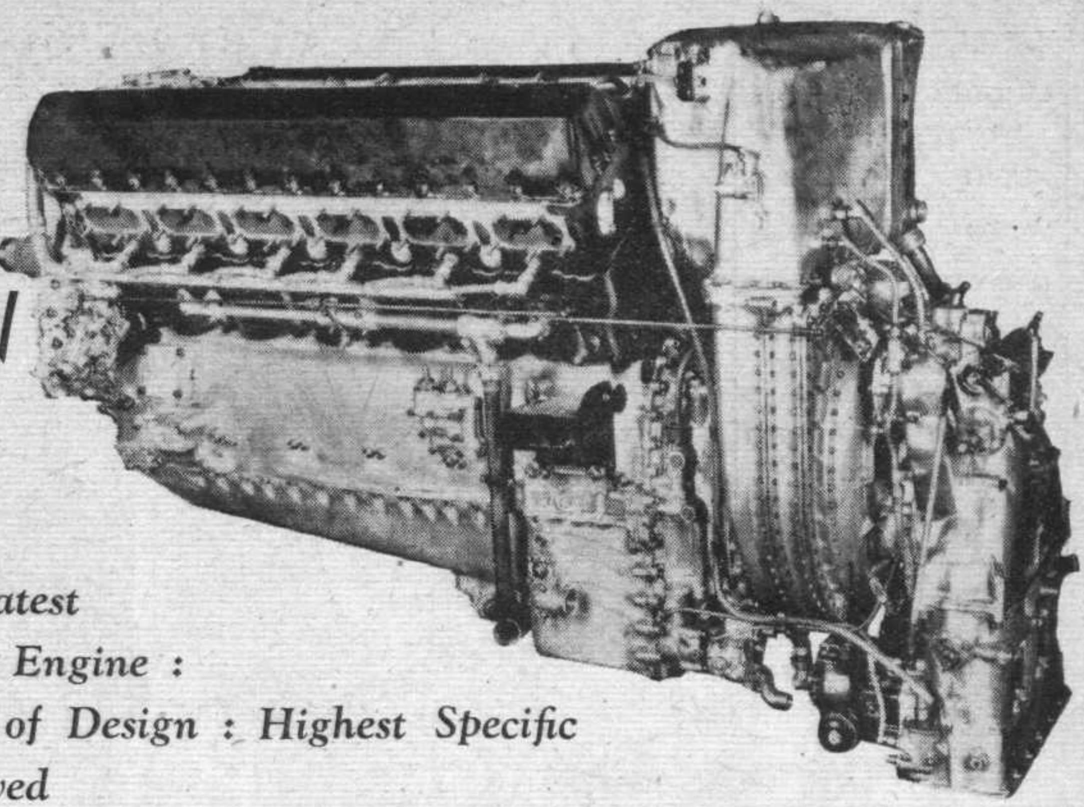
ROLLS-ROYCE GRIFFON (65)



Review of the Latest Rolls-Royce Piston Engine : Classic Orthodoxy of Design : Highest Specific Powers Yet Achieved

WHEN confronted with the Rolls-Royce Griffon for the first time, the facile result of an initial rapid appraisal is that the engine is nothing much more than a scaled-up Merlin, and, although there is doubtless a certain amount of justification for this view, it is not wholly accurate. In actual fact, as one's investigations progress, the impression is steadily strengthened that, far from being merely a scale-up of an existing engine, the Griffon is an entirely new engine in its own right. It would, however, probably be pretty accurate to hazard the assumption that the Griffon was born of a desire to redesign the Merlin, eliminating all the snags and, at the same time, increase the capacity to meet the imminent demand for a larger engine whilst retaining the smallest overall dimensions possible.

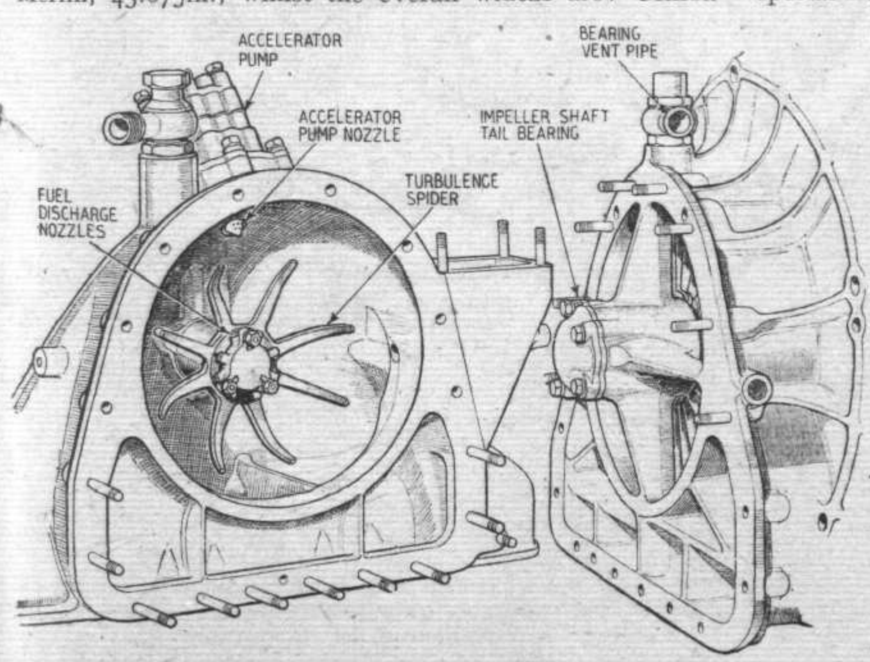
How well the men of Derby have succeeded in doing what they set out to do may be appreciated in part by a comparison of overall dimensions as between Griffon and Merlin, together with the respective swept volumes and piston areas. In overall length the Griffon 65 is 81in., three inches longer than the 78in. of the equivalent Merlin, the 66; overall heights are respectively, Griffon, 45in., and Merlin, 43.675in., whilst the overall widths are: Griffon 29.5in., and Merlin 29.825in. It would seem well-nigh impossible, on the face of it, that with such similarity of overall dimensions in two engines of the same basic type, the swept volume of one should be 35.9 per cent. larger than that of the other. Such, however, is the case. Piston area of the Griffon is 23 per cent. greater than that of the Merlin, this having been achieved by increasing the cylinder bore to 6.0in.: a figure which is just about verging on the optimum limit.

In view of this one is led to wonder what form the Griffon's successor will take; the useful limit of piston diameter having been reached, one is forced to the conclusion that any larger capacity piston engine that Rolls have in mind to follow the Griffon will, of necessity, have more cylinders. It is an interesting speculation which naturally, and on precedent, takes it for granted that Derby *do* intend to produce a new and bigger orthodox engine.

Influence of the Racing "Buzzard"

Before going on to deal with the Griffon, a word should be said on the prevalent and somewhat erroneous assumption that the engine is a counterpart of the famous "R" special Buzzard racing engine which secured the Schneider Trophy for England in 1929 and 1931, and established a World's Speed Record. Certainly, the bore and stroke size are the same and so is the fundamental layout of the engine—but there the similarity ends. It can truthfully be said that the lessons learned on the "R" engine have had their influence on all the subsequent Rolls engines, but equally, the knowledge gained in the Merlin has resulted in the refinements which distinguish the Griffon. The one particular feature which the Griffon owes directly to the "R" is the crankshaft, for the amount of development put into this member on the racing engine virtually paved the way towards making the Griffon a success from the very beginning of its life.

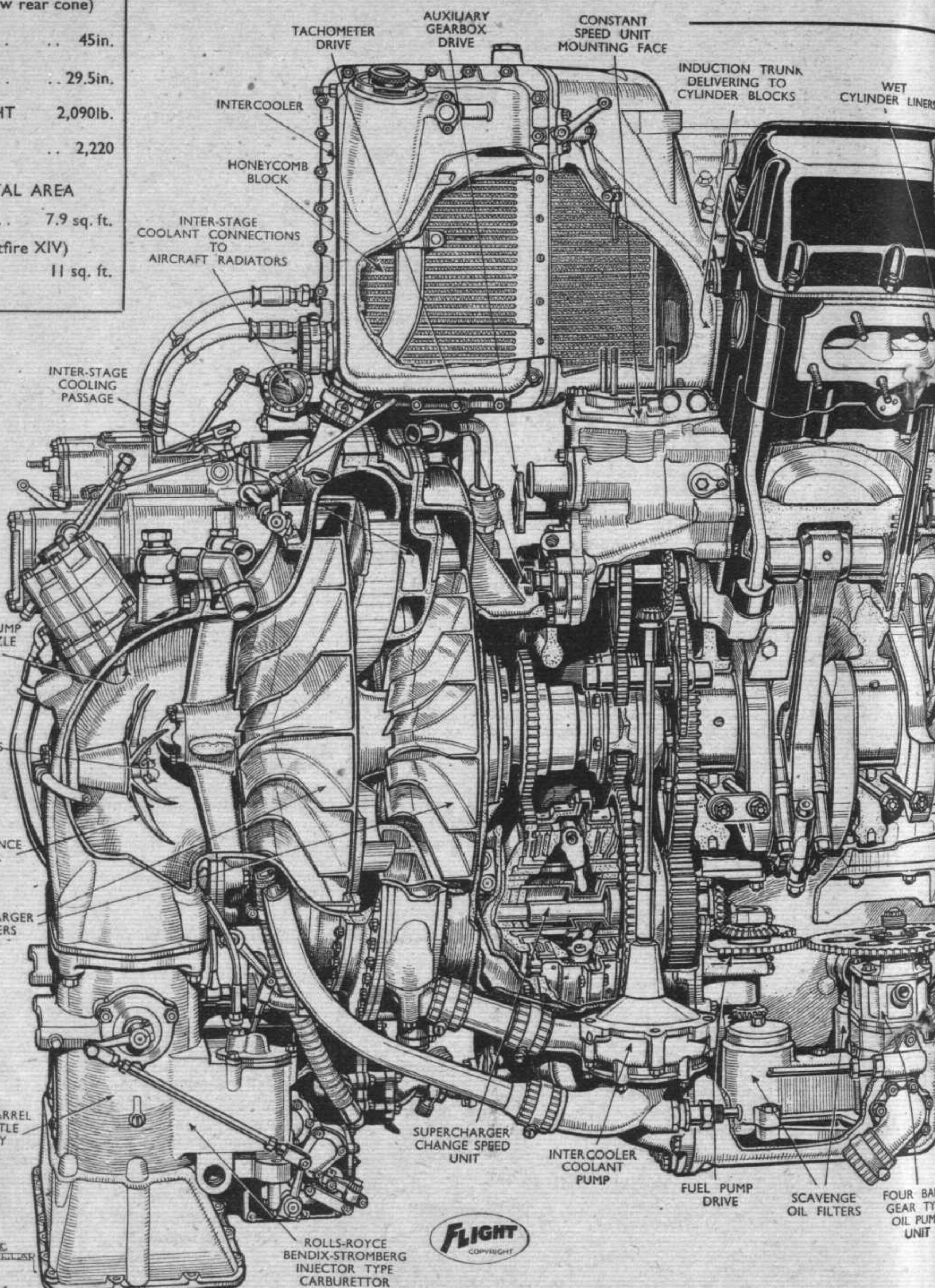
It is not, perhaps, generally known that the Griffon was originally developed primarily to meet the Fleet Air Arm's specific needs—low-altitude power, ease of service, reliability, etc. In the early days of



Induction throat to impellers showing turbulence spider with fuel nozzles.

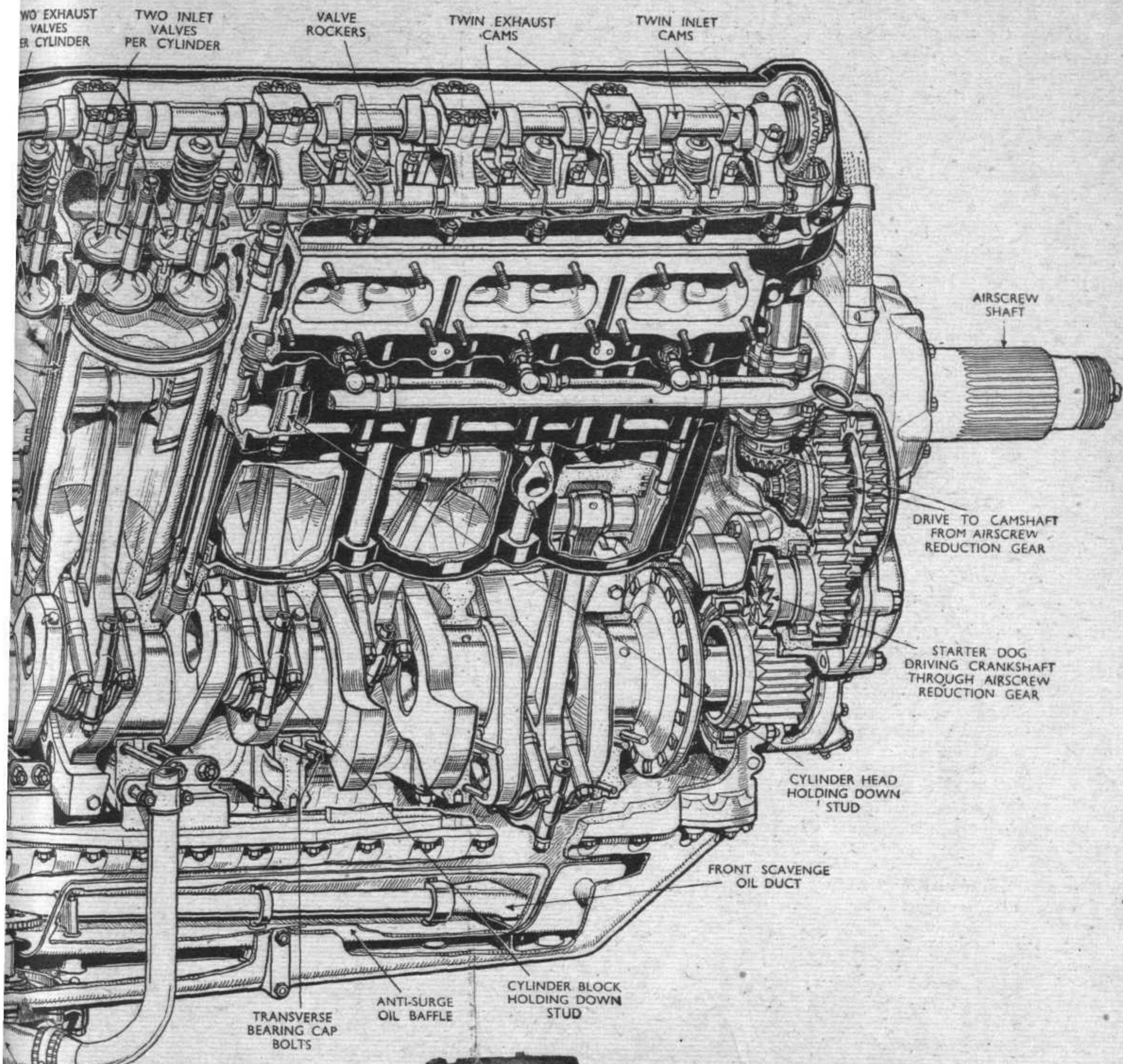
LENGTH	81in.
(to airscrew rear cone)	
HEIGHT	45in.
WIDTH	29.5in.
DRY WEIGHT	2,090lb.
MAX. B.H.P. ..	2,220
FRONTAL AREA	
Bare engine ..	7.9 sq. ft.
Installed (Spitfire XIV)	11 sq. ft.

ROLLS



This special copyright *Flight* drawing by Max Millar lays bare the component arrangement and structural design of the engine. In beautiful piece of work be illustrated more effectively, and, further to emphasise this point, the reader may refer between the e follow the disposition of the various units.

OYCE GRIFFON (65) ENGINE



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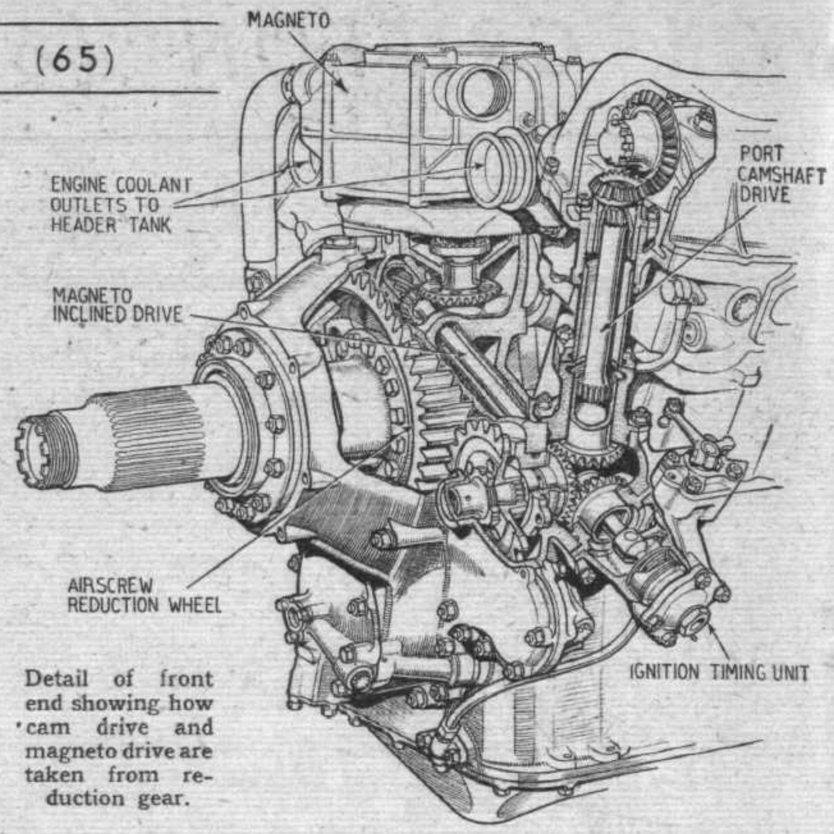
the war the Griffon was rather displaced by the Vulture until the latter was discarded, then the Griffon was resurrected as the need for a larger engine than the Merlin was again realised as a necessity. The various marks of Merlin Spitfires were capable of handling enemy aircraft at height, but when the Fw 190 was de-rated to give maximum performance low down we were somewhat pressed. A quick decision was reached to put the Griffon II into some Spitfire VIII's, which then became the mark XII; these were built in limited numbers, but effectively squashed the opposition.



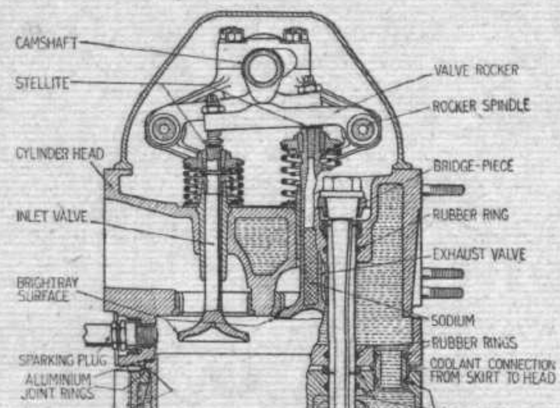
Detail of front end showing how cam drive and magneto drive are taken from reduction gear.

F.A.A. and R.A.F. Requirements

These models of the Griffon were all fitted with single-stage, two-speed blowers, and this basic type has progressed for Fleet Air Arm use (*vide* the Fairey Firefly), whilst the special needs of the R.A.F. have been met by the two-speed, two-stage engine for high-altitude use. As may be expected, the Griffon owes a fair amount to Merlin development, but what is peculiarly interesting is that various practices initially proved on the Griffon have been incorporated in the later Merlins.

Basically the engine is, of course, on the same lines as the Merlin, although the detail design is new pretty well throughout. One of the most important innovations is in taking the cam- and mag-drives from the front. This was decided upon in order to relieve the valve operation from as much variation as possible: by interpolating a semi-floating coupling between the crankshaft and the driving wheel of the reduction gearing and, in addition, by taking the cam drives from the airscrew-driving gear, angular variations in crankshaft speed are greatly reduced in their transmission to the camshafts. Further, airscrew inertia results in a reasonably constant rate of r.p.m., and, to top-off the advantages, the front drive allows a comparatively shorter overall length which, in turn, permits the larger and more powerful engine to go into existing fighters.

Whilst on the subject of the crankshaft, we might as well deal with that interesting component. It is, of course, machined all over from a forged billet, and is fully counterbalanced, the front throw of No. 1, both throws of No. 4 and the rear throw of No. 6 bearings each having a separate balance weight bolted to them. Vibratory troubles in the crankshaft have been very few, but a pointer to the Derby standard is that the firing order geography was selected to give optimum crankshaft harmonics.

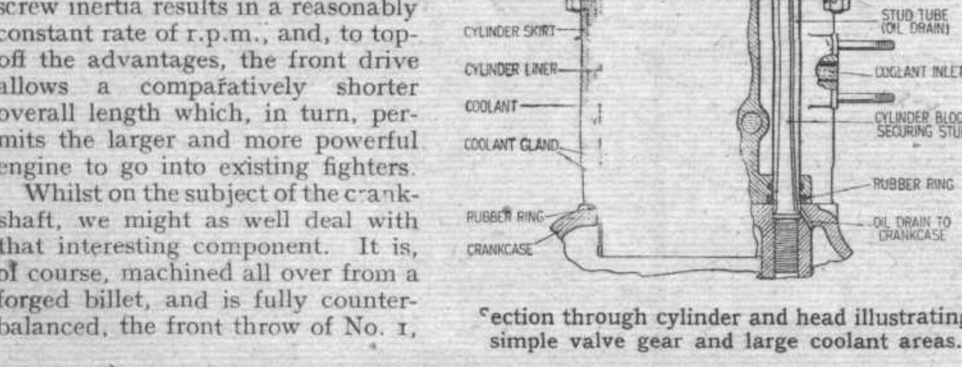


Section through cylinder and head illustrating simple valve gear and large coolant areas.

Crankshaft Lubrication

Perhaps the most novel feature of the crank assembly is that the main bearings and big ends are all lubricated from the hollow interior of the shaft. This scheme, though novel, is by no means new, Rolls having first tried it years ago; however, the Griffon is the first Rolls engine in which it has become practice. Feed is into each end of the shaft and, in addition to the system pressure, shaft rotation provides a "built-in" centrifuge. A great advantage of the system is that the amount of oil supplied to each bearing is not influenced by relative shaft/bearing movement. In addition, each main journal has internal standpipes which act as sludge traps as well as permitting, by a variation in their diameter, a means of metering or controlling the amount of oil supplied to any particular bearing.

Another interesting feature of the crankshaft is that it is rigidly connected neither to the front nor the rear driven members. At the front end an internally toothed annulus is bolted on, this meshing with and housing a semi-floating ring which itself is internally splined to a coupling shaft. The latter is splined at its front end to the driving wheel of the reduction gear so that this mechanism is



Three-quarter front view of crankshaft with semi-floating toothed annulus in front coupling. Note the detachable counterweights on crank throws.

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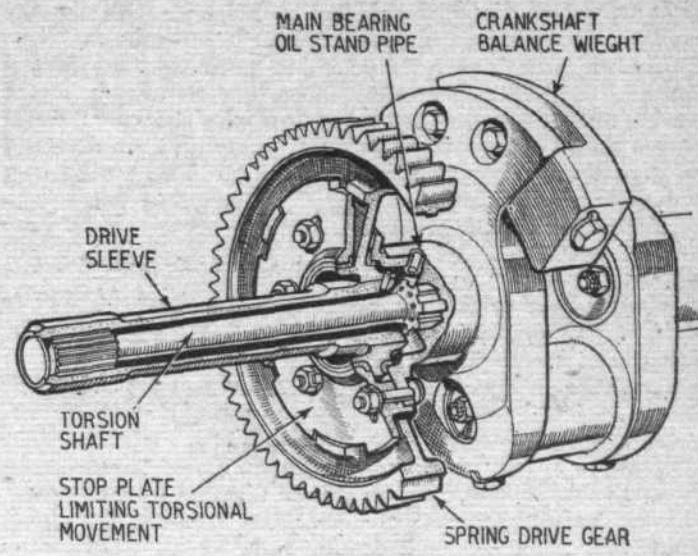
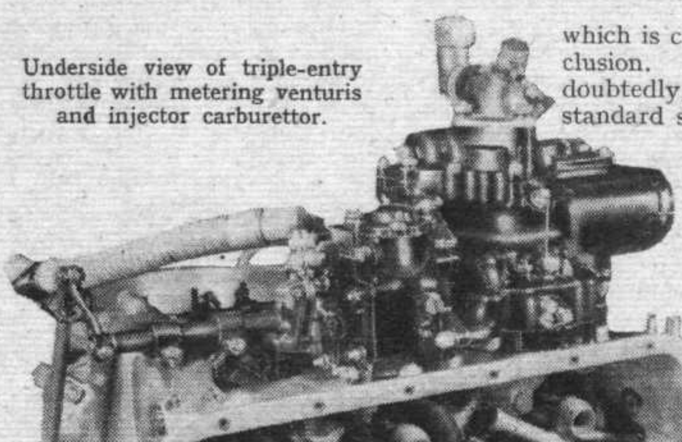
partly relieved from crankshaft rotational variations and totally relieved from end-float effects.

Going to the other end of the shaft, we encounter the beautifully neat torsional spring-drive coupling, the purpose of which is to relieve the crankshaft from impeller inertia. When the throttle is opened quickly the "flywheel" inertia of the impellers does not allow them to be accelerated as quickly as is the crankshaft by the pistons, and the resulting lag engenders a tendency to twist the crankshaft. Again, when the throttle is rapidly closed the impellers try to overrun the crankshaft, with reversed but similar twisting effect. To relieve the shaft from these embarrassments a spring drive is embodied between shaft and impellers, which absorbs the initial shock loading resulting from the inertia. The coaxial shaft and sleeve which, splined together, form the springing member, are shown in a detail drawing.



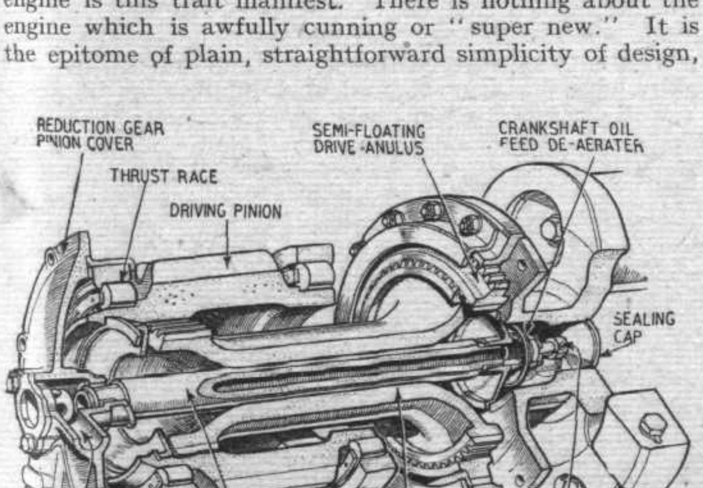
Three-quarter rear detail of torsion spring drive coupling at rear end of crankshaft.

There is not such a number of gears at the rear end of the Griffon as is found in the Merlin, the front-end cam-drive arrangements, etc., being the cause; nevertheless, there is still a goodly number of wheels, bearings and shafts at the back of the Griffon, and to attempt to describe these individually would, as well as being tedious, serve no worthwhile function. They can almost all be traced in the Max Millar drawing and other details; however, it is worthy of emphasis that the nesting of this mass of drives is as compact and neat as the highest order of mechanical design ingenuity can make it.



Underside view of triple-entry throttle with metering venturis and injector carburettor.

In the title sub-heading of this article are the words "Classic Orthodoxy of Design," and in the Griffon probably more than in any other Rolls engine is this trait manifest. There is nothing about the engine which is awfully cunning or "super new." It is the epitome of plain, straightforward simplicity of design, which is carried to the absolute of logical conclusion. It is for this reason, almost undoubtedly, that the Griffon carries further the standard set by the Merlin as being the highest performance engine in existence, for other engines of similar power are larger or, if of the same size, are lower powered. Such a feature, when coupled to great reliability, cannot well be achieved by "mushroom" methods—it comes only by way of lineage of thoroughbreds born of painstaking care and unrivalled experience. It is on this foundation that the name Rolls-Royce rests so securely.



Three-quarter front view of semi-floating coupling between crankshaft and reduction gear.

The main body of the Griffon is not unlike the later Merlins in that it has a light-alloy pentagonal-section crank-case, the lower half of which is a dry sump housing the oil pressure and scavenge pumps with their filters in a well at the rear end. A baffle plate is also embodied in the lower half case to restrict oil surge and prevent excessive breathing under negative G accelerations. Cylinders are floating wet liners fitted in light alloy jacketing blocks, the compressive stress due to the holding-down studs being taken by the jacket. The liners are chromium plated in the bores for about 2½ inches down from the head as an anti-war measure, it being in this area that maximum wear from corrosion and great temperatures occurs. A flange is incorporated round the head of the liner, and, with aluminium sealing rings above and below, is nipped between the cylinder head and jacketing block. Thus all thermal expansion and contraction of the liner takes place relative to the lower end.

This fashion of nipping the liners at the top means that, when tightened down, there is a gap of 0.15 in. between adjacent faces of the cylinder-head block and the jacketing block which, until one knows the reason, looks very queer. To prevent excessive cantilever loading on the joints adjacent to the end studs when at normal running temperatures, flat steel plates are interposed at each end of the cylinder bank between head and jacket, these plates transmitting the load as the engine warms up.

Combustion chambers are machined all over and are quite orthodox in shape. Valve seats are shrunk-in inserts and the porting passages are scurfed—very smoothly indeed on the inlet side (as is to be expected), but fairly roughly on the exhaust side. The valves have Brightray seat facings and, whilst the inlet valves have extended guides, the

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exhaust valves are partially filled in the stems with metallic sodium.

Rocker gear is very similar in design to that of the Merlin, the central camshaft operating the two rows of valves through cantilever rocker arms. The cams themselves are of reasonably quick-lift profile and are designed to give harmonic negative acceleration. Two springs per valve are employed, of opposite helix and differing periodicity, the latter being an anti-surge measure.

The ignition system of the Griffon is well worthy of attention, not so much as a system, for the plugs and screening harness are standard, but in view of the unusual timing arrangement and very efficient magneto. This is a B.T.H. duplex type which runs at half engine speed, being driven through bevel gears from an inclined shaft taken from the base of the port bank camshaft drive. The timing arrangement is "built-in" to the inclined shaft and comprises a hydraulic ram, at the base of the shaft, subject under control to engine oil pressure which is used to alter, as required, the linear position of the inclined shaft. At the top end, the shaft is helically splined to the mag.-driving bevel so that linear motion of the shaft will, via the helical splines, cause a change in the relative positions of the cam and rocker pad in the magneto to achieve the desired timing—i.e., the cam is caused to strike the pad at an earlier or later point of crank angle. Additionally, as the power input to change the timing is provided by oil pressure, the pilot's control loading is extremely light; in fact the only load is that needed to operate a small pilot valve to regulate oil flow to the ram.

Mention of pilot's controls leads one naturally to consideration of what, in the writer's opinion, is most aptly called the "power lever control" system. Briefly, what this means is that, instead of the normal cockpit arrangement comprising separate throttle and airscrew or, rather, r.p.m. controls, a single "power" lever is fitted which governs the boost, r.p.m and ignition. Maximum performance (that is, max. r.p.m. and max. boost) is obtained at full forward movement of the single power lever, and at intermediate positions of the lever suitable combinations of boost and r.p.m. are obtained for various other flight conditions.

Override Essential

There is little doubt that this scheme is a most useful one in that it relieves the pilot from responsibility in ensuring that the engine is always operating under the best conditions. However, it is rather essential that an override control be fitted to allow normal separate settings of boost and r.p.m. when required—for example, when landing or in combat. The Griffon *is* provided with an override lever for these particular functions, and there is every reason to suppose that, despite the innate conservatism of pilots, nothing but advantage can result from the use of the power lever control.

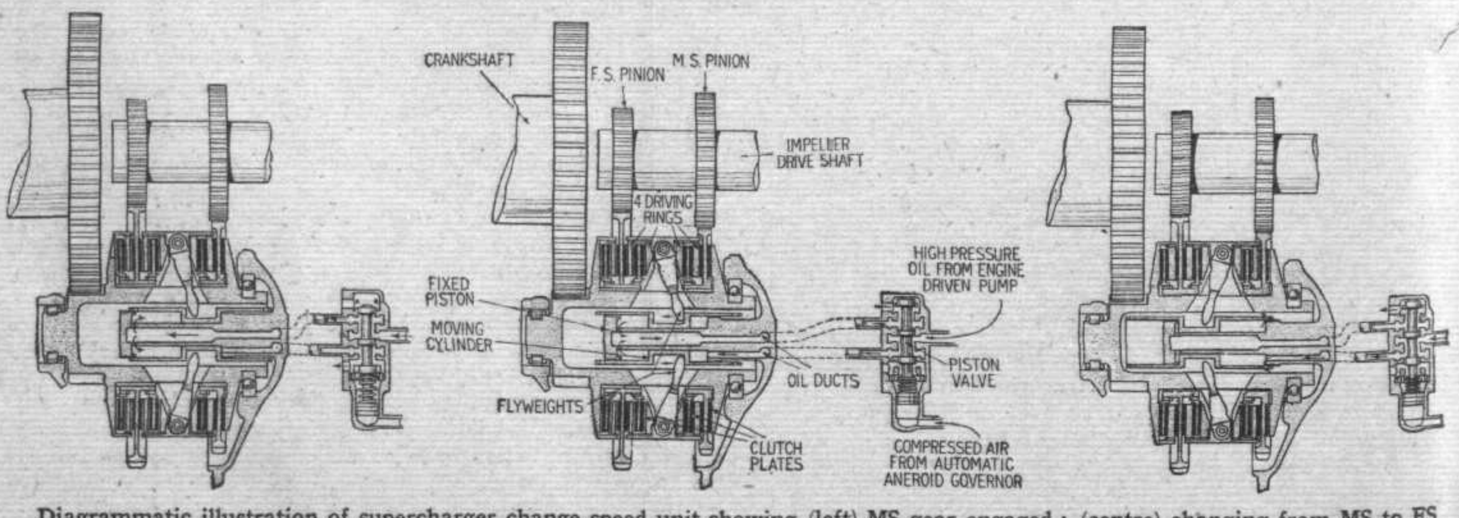
Further to ensure the most advantageous and safe operation of the engine, a boost regulator unit is fitted, the purpose of which is to restrict boost pressure below full-throttle height to a safe maximum. As may be realised, although the maximum boost pressure of the Griffon 65 is nominally 21 lb./sq. in., the blower is capable of delivering nearly twice this pressure at low altitudes, and in order that the pilot can slam forward the lever to obtain maximum power without having to worry about the safe boost limit, and to save the possibility of the engine from disintegration with expensive noises, a regulator unit is installed which limits the delivery below throttle height for whatever boost is being used in the appropriate gear. The regulator comprises an aneroid-controlled relay piston linked to the throttle butterflies by a differential gearing to shut off the degree of throttle opening as necessary. The relay piston is subject to the differentials of blower intake and delivery pressures, so that if, for example, combat climb is required from the ground up, as altitude is gained the aneroid capsule tasting the boost will move a piston valve to admit the pressure difference across the blower to the relay piston to open the throttle progressively and maintain boost up to full-throttle height.

Powers and Future Use

Whilst on the question of powers it is noteworthy that the *continuous cruising* powers of the Griffon 65 are well over 1,000 h.p. from sea level up to over 30,000ft. Compare this with the original Merlin at the outbreak of war which had a maximum S.L. power of 880 h.p. (at $6\frac{1}{4}$ lb. boost) rising to 990 at 12,250ft., the maximum rated height.

Although the Merlin is such a magnificent engine—the outstanding engine of all time—as an alternative for future air liners, it would surely be sensible to instal a derated Griffon to give similar performance more economically and, at the same time, gain all the benefits of advanced development. It is not without significance that the Griffon is one of the very, very few engines ever to have succeeded to general service without experiencing modifications necessitating grounding. There is, too, a good deal of advantage the Griffon has over the Merlin on the subject of servicing and maintenance.

We have mentioned that the maximum boost of the Griffon 65 is 21 lb./sq. in., but there are other models in existence which have been passed for 25 lb./sq. in. maximum boost (with 100/150 grade fuel) and the maximum powers in the respective moderate and full supercharge gears have thus been stepped up to: MS, 2,375 b.h.p. at 1,250ft., and FS, 2,140 b.h.p. at 15,500ft.



Diagrammatic illustration of supercharger change-speed unit showing (left) MS gear engaged; (centre) changing from MS to FS gear; and (right) FS gear engaged.

LEADING PARTICULARS

Type	Pressure liquid-cooled, in-line 60 deg. V.
No. of cylinders	12, arranged in two monobloc banks of six with detachable heads.
Bore and stroke	6.0in. × 6.6in.
Unit capacity	186.6 cu. in.
Total swept volume	2,239 cu. in. (36.7 litres).
Reduction gear	Direct spur gear—Ratio: 0.5102 : 1.
Rotation	Left-hand tractor.
Airscrew shaft size	No. 5 S.B.A.C. Standard.
Valve type	Poppet—exhaust valves sodium cooled.
No. of valves/cylinder	Four, quadrantly disposed.
Supercharger	Centrifugal two-speed two-stage with inter-cooler.
Carburettor	Rolls-Royce Bendix-Stromberg pressure injection type 9T/40/1 triple-entry up-draught.
Magneto	B.T.H. C.S.H. 12-125/3 duplex type with integral distributors.
Plug positions	Two/cyl. diametrically opposite and radially disposed one each to inlet and exhaust sides.
Firing order	(P = port; S = starboard) 1S, 4P, 3S, 2P, 5S, 1P, 6S, 3P, 4S, 5P, 2S, 6P.
Ignition timing	Fully advanced: Inlet plugs 45 deg. before T.D.C. Exhaust plugs 51 deg. before T.D.C. Fully retarded: Inlet plugs 10 deg. before T.D.C. Exhaust plugs 16 deg. before T.D.C.
Crankshaft type	Counterbalanced six throw.

BEARINGS

Main bearing diameters	3.75in.
Main bearing areas	Centre, 5.45 sq. in. Ends and inters, 5.12 sq. in.
Big-end diameter	Fork rods, 3.10in.; plain rods, 3.773in.
Big-end areas	Fork rods, 6.28 sq. in.; plain rods, 2.61 sq. in.
Gudgeon diameter	1.50in.
Total gudgeon bearing area	6.83 sq. in.
Rod/gudgeon bearing area	2.976 sq. in.
Piston/gudgeon bearing area	3.854 sq. in.
Con. rod length, centre to centre	10.65in.
Ratio of con. rod length to stroke	$1.614 : 1 \frac{L}{R} = 3.228$.
Max. angularity of con. rod	18 deg.
Cam base circle dia.	1.150in.
Cam major axis length	1.5308in.
Valve lift	0.570in.

WEIGHT

Power/weight ratio	0.941 lb./b.h.p.
Weight/sq. in. piston area	6.159 lb.
Max. mean piston speed	3,025 ft./min.
Weight of piston and rod ass'y/cyl.	12.23 lb.

ASPIRATION

Valve timing	Inlet opens 24 deg. before T.D.C.; closes 44 deg. after B.D.C. Exhaust opens 64 deg. before B.D.C.; closes 4 deg. after T.D.C.
Inlet port area (valve throat)	5.54 sq. in./cyl.
Exhaust port area (valve throat)	4.12 sq. in./cyl.
Piston area to inlet valve area ratio	5.103 : 1
Piston area to exhaust valve area ratio	6.867 : 1.
Ratio of piston area to frontal area	0.298 : 1.
Cylinder compression ratio	6 : 1.
Max. internal compression ratio of blower	5.3 : 1.
Impeller diameters	1st stage, 13.4in.; 2nd stage, 11.3in.
M.S. gear ratio	5.84 : 1.
F.S. gear ratio	7.58 : 1.
Equivalent tip speeds	M.S. cruising, 1,071 ft./sec.; M.S. max. power, 1,228 ft./sec. F.S. cruising, 1,391 ft./sec.; F.S. max. power, 1,594 ft./sec.
Eye area of 1st impeller	56.1 sq. in. free, 40.5 sq. in., restricted by tail bearing support.
Rich mixture ratio	11 : 1 by weight.
Weak mixture ratio	14 : 1 by weight.

POWER

Max. boost pressure	21 lb./sq. in.
Max. cruising boost pressure	7 lb./sq. in.
Max. b.h.p.	2,220.
Max. r.p.m.	2,750.
Cruise r.p.m.	2,400.
Max. b.m.e.p.	286 lb./sq. in.
Altitude to which 1 ata. manifold pressure is maintained	39,500ft. in F.S. gear.
Power/cu. in. swept volume	0.992 h.p.
Power/litre	60.5 h.p.
Power/sq. in. piston area	6.54 h.p.
Power/sq. ft. frontal area	281 h.p.
Power ratio/sq. in. piston area to sq. in. frontal area	3.35 : 1.

AUXILIARY DRIVES

Auxiliary drive speeds (ratio relative to crankshaft)—

Tachometer	0.250 : 1.	
Gearbox input	0.984 : 1	(Accessory drive faces: hydraulic pump, electric generator, air compressor, vacuum pump).
Magneto	0.50 : 1.	
C.S.U.	0.82 : 1.	
Fuel pump	0.887 : 1.	
Oil pumps	0.984 : 1.	
Engine coolant pump	1.793 : 1.	
Inter-cooler coolant pump	1.799 : 1.	
Starter	1 : 1.	
Type of starter	Coffman combustion type L5.	

The very high output of the engine would not be possible without the two-speed two-stage supercharger which, although of greater capacity, seems to be smaller than that of the equivalent Merlin; nevertheless, a price of no less than 600 h.p. is paid in driving the supercharger and, even more amazing, this power is transmitted through relatively small friction clutches in the speed change unit. A driving wheel on the spring drive coupling at the rear of the crankshaft meshes with a hollow layshaft in the change-speed unit, this layshaft housing a stationary piston and sliding cylinder assembly. Mounted on the layshaft are a series of clutch plates and driving rings on each side of a driving member in which are pivoted six fly-weights; the clutches on the crankshaft side of the central weights are for full supercharge drive (F.S.), whilst those on the impeller side of the weights are for moderate supercharge (M.S.), the respective clutches transmitting the drive through gears which mesh with pinions on the impeller shaft.

When, for example, M.S. drive is in operation, the fly-weights are held inclined rearwards by centrifugal force to engage the clutch plates of the M.S. gear, and, as the F.S. clutches are disengaged and doing no work the driving gears can both be in constant mesh with the impeller pinions.

Automatic Blower Gear Change

If the aircraft climbs into an altitude range where F.S. gear is required, the change of speed is effected automatically by a selector mechanism which actuates a piston valve so that oil delivered by the special pump in the crankcase is directed to the appropriate side of the change-speed unit piston. The pressure exerted against the piston reacts on the cylinder causing it to move, and by so doing, push the fly-weights away from the M.S. clutches towards the F.S. clutches; as the weights move beyond the neutral plane centrifugal force again takes hold and forces them to engage the F.S. clutches which thereupon transmit the drive through the high-speed F.S. gear.

The automatic selector mechanism which effects the blower speed change comprises an aneroid capsule which operates a micro-switch to open a valve in the aircraft's air supply, and so pass compressed air to a ram on the end of the piston valve which directs the distribution of oil to the change-speed unit. However, the pilot is provided

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with a change-speed switch to by-pass the aneroid and thus permit a change in blower speed for emergency use, to allow of retaining low gear for formation flying, or to allow of ground testing.

In order that no ill effects result from small axial movement as between the driving gears of the speed-change unit and also to preclude the effects of an over-hung drive, the respective drive pinions on the impeller shaft are not integral. In point of fact, only the M.S. pinion is mounted on the impeller shaft itself, the F.S. pinion being supported in a housing around the spring-drive sleeve, with a bell coupling separating the pinions and splined to each.

Induction is updraught through a triple-barrel throttle in the mouths of which are the venturis for fuel metering balance. The carburettor is a Rolls-Royce modification of the Bendix-Stromberg metering injector, and supplies a governed measure of fuel to a series of discharge nozzles arranged in a "hub" from which project eight "spokes." On the downstream side of these is created a depression or turbulent area into which the fuel nozzles discharge, and from here the mixture is taken straight into the eye of the first-stage impeller. Rectifying and diffuser vanes are interposed between the first and second impellers, and in this inter-stage area the blower casing is cooled by its own little coolant system. From the second-stage impeller the charge is passed through a further diffuser ring and so to the volute delivering to the intercooler. An accelerator pump is located in the up-draught throat between the nozzle spider and the impeller eye, and discharges through a single nozzle.

The inter-stage impeller case cooling has the effect of increasing the charge density as an intermediate measure, and by so doing increases the capacity efficiency of the second stage. This principle lies behind the use of the main intercooler, for an increase in charge density for a given volume enhances the volumetric efficiency, and although this leads to a large flow through the carburettor and, thus, a higher consumption, relative to the power increase, the step-up in consumption is well worth while.

For the future, Rolls-Royce have evolved a metering pump to supplant the present system, and it also seems likely that water/methanol injection will be introduced before very long, not necessarily only as an emergency measure but as a normal running condition. Direct injection to individual cylinders will also, without doubt, eventually be incorporated. There is this to be said for the new metering pump: it is an extraordinarily simple unit of great reliability and meters so accurately throughout the whole performance range that it is not too much of an exaggeration to state that flights could be planned to within a half-gallon of fuel endurance. With this is naturally linked a control and pre-knowledge of specific consumption such as has never before been known.

Sir Arthur Tedder's Promotion

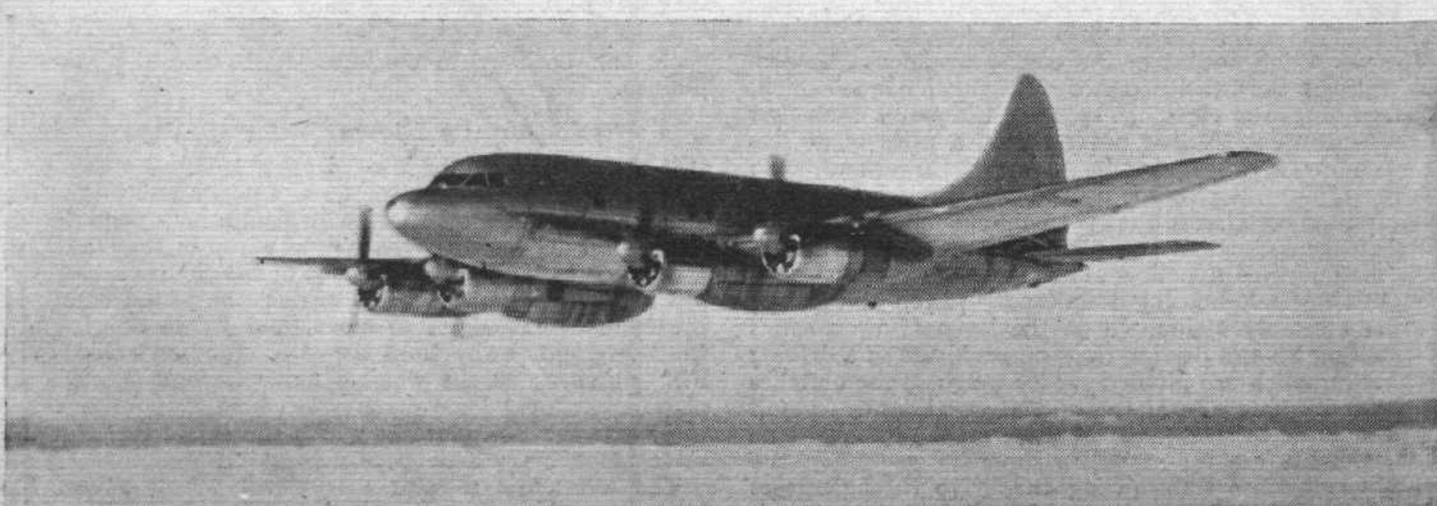
Deputy Supreme Commander Becomes Marshal of the Royal Air Force

THE *London Gazette* of September 11th announced the promotion of Air Chief Marshal Sir Arthur Tedder, G.C.B., to Marshal of the Royal Air Force.

Marshal of the R.A.F. Sir Arthur Tedder, G.C.B.

The public remembers Sir Arthur chiefly as having been A.O.C.-in-C. the Mediterranean Air Command from 1943 until he was appointed Deputy Supreme Commander of the Allied Armies of Liberation under General Eisenhower. But his earlier career had been full of promise. He entered the Army in 1913 with a University commission from Cambridge, where he was at Magdalene College. As an undergraduate he gained a University prize for an essay on the Navy of the Restoration, which was favourably reviewed in *The Times*. His first commission was in the Dorset Regiment, and with it he went to France in 1914. Thus he belongs to the honourable company of "Old Contemptibles." In 1916 he was seconded to the Royal Flying Corps, and during the war was mentioned several times in despatches. At the battle of Arras in 1917 he commanded No. 70 Squadron, which was equipped with 18 Sopwith two-seaters.

Since the 1918 Armistice Tedder saw service during the Chanak crisis in 1922. In 1928 he attended a course at the Imperial Defence College—a very good preliminary for his subsequent post as Deputy Supreme Commander of British and American forces of all Services. In 1936 he was appointed A.O.C. Far East Command, with headquarters at Singapore. He has also held various important posts at the Air Ministry, including that of Director-General of Research and Development and Director of Training.



LINCOLN'S CIVIL SISTER : A new photograph of the Avro Tudor I doing a little overweather flying. The wing arrangement of the Lincoln and the Tudor I is identical.