in the supercharger drive. The engine would presumably give a rated power of 1,600 h.p. at 2,400 r.p.m. It will be seen that the blower absorbs about 20 per cent. of the rated power at 10,000ft. and 40 per cent. at 30,000ft. On the other hand, the rated power decreases with altitude, owing to the decrease in charge weight, as already seen. The same Fig. 4A shows also the power absorbed in supercharging a 1,600 rated h.p. four-stroke engine (with 3 lb./sq. in. boost), which is roughly half that of the two-stroke. This must therefore have a larger blower and, which is worse, an inter-cooler twice as large.

The situation changes completely if scavenging and supercharging are separated in the two-stroke aircraft engine. That is, if scavenging is effected at low pressure and turbulence while the exhaust is open, and supercharging is effected at higher pressure and turbulence after the exhaust has closed (the supercharging ports can, of course, begin to open while the exhaust valves are not yet quite closed). In this case turbulence conditions are right both for scavenging and for combustion, and do not alter with altitude. The supercharge pressure is recuperated and, if it is kept constant, the weight of charge and power do not vary with altitude. The excess air ratio also remains unaltered, provided the scavenging air is given a constant pressure rise above the surrounding atmosphere. This can be done very simply by giving the scavenge blower a fixed gear ratio. A blower of this type works at constant inlet volume and remains, therefore, always in the high-efficiency region of its curve. At least 75 per cent. can be expected. The axial compressor, with efficiencies above 85 per cent., would be well suited to this constant-volume work.

Power Saved

The weight of air at (or above) ground pressure to be provided by the supercharging compressor increases with altitude. The power spent in compressing the charge up to ground conditions cannot, of course, be saved, but the power wasted in needlessly compressing the excess air is saved in this type of two-stroke engine. The supercharging ports must be kept open even when the piston has risen well above bottom dead centre. It must be noted in this connection, however, that in a naturally aspirated four-stroke engine at 20,000ft. the pressure in the cylinder is below ground atmospheric, even when the piston is well above half-stroke. Incidentally, the separation between scavenging and supercharging allows a high boost to be used during take-off.

In Fig. 4B is shown the power spent in scavenging and supercharging a 36-litre two-stroke engine with separate scavenge. The scavenge blower, driven at constant ratio, is assumed to have 75 per cent. efficiency. The supercharging blower, driven at variable ratio and giving constant absolute pressure, is assumed to have 70 per cent. efficiency. It will be seen that the power absorbed by scavenging decreases with altitude, due to the decreasing specific weight of the air, while the power spent on supercharging increases rapidly as both pressure and weight of air needed to complete the charge rise with altitude. The total power spent on scavenging and supercharging is practically the same as that of the four-stroke of Fig. 4A and only half that of the ordinary two-stroke. The inter-cooler is actually smaller than that of the four-stroke as the scavenge air does not need cooling owing to the low compression ratio. There is the added advantage that the scavenge air becomes colder with altitude, thus improving cooling conditions.

The gross engine power output increases with altitude, as the outside pressure decreases while the pressure at the end of exhaust remains constant. The best division between supercharging and scavenging differs from that assumed in calculating the curves of Fig. 4B, the results being even more favourable. It can be safely stated that the two-stroke engine with separate scavenging and supercharging is better adapted to altitude work than the four-stroke engine. The superchargers, though slightly larger than in a four-stroke, are no more complicated than the two-stage blower required by any engine flying above 20,000ft.; the inter-cooler is much smaller, a saving of over 30 per cent. being possible.

Sleeve-valve Control

The distribution and inlet arrangements are certainly more complicated than in a normal two-stroke engine. It must be noted, however, that both scavenge and supercharge air are at low pressure and temperature, while a distributor is needed in any case to shorten the piston. A single-sleeve valve can provide the desired control and separation of scavenge and supercharge air; but a well-designed distributor can give even better results, with a shorter and cooler piston.

No mention need be made here about petrol injection and safety fuels; all interesting results that are not secret are being published. It must only be noted that, in a two-stroke engine with separate supercharging ports, it may be possible to place the injector in the ports and not in the cylinder; this would allow a slightly longer time for vaporisation. What has been said about the two-stroke petrol engine applies, of course, with even greater force to the aircraft C.I. engine where, owing to the high thermal efficiency, piston cooling problems are easy to solve.

It is impossible to foresee exactly the best b.m.e.p. that will be obtained in a reliable two-stroke petrol engine. As in all aero engine development, peak results become average performance in a couple of years. 115-120 lb./sq. in. at rated power and 2,500-2,750 ft./min. piston speed can be expected to begin with. During take-off the b.m.e.p. can certainly be increased very considerably. With a few years' experience better figures should be reached. Petrol consumption will probably be 5 to 10 per cent. higher than that of the best four-stroke engines. On the other hand, as the two-stroke need not be any larger or heavier than a four-stroke of the same capacity, the weight per h.p. should be much better than in the best present-day engine. The same applies to compactness. These qualities seem to indicate the two-stroke engine as particularly suitable for fighters, also owing to its fitness for altitude work. The good take-off power should be useful for flying boats.

The time is ripe for the appearance of the practical two-stroke aero engine. If the first types tested under service conditions are well designed, the two-stroke will soon find its place in the aircraft engine field. Clever design and ingenuity will be needed, however. They are catalysts or vitamins without which no amount of laboratory or bench work can hope to overcome the tremendous start that years of practical experience have given to the four-stroke engine.

RATIONALISATION

DURING the last week or so the Government has taken steps to speed up production of armaments of all kinds. In addition to the Light Alloys Committee, of which Mr. F. S. Spriggs is chairman (announced in last week's issue) the Ministry of Aircraft Production has appointed emergency committees to deal with airframe production and with the supply of alloy steels used in the aircraft and aero engine industry.

The chairman of the Airframe Production Emergency Committee is Mr. F. S. Spriggs, of the Hawker-Siddeley group, and members of the committee are Mr. C. R. Fairey, chairman of the Fairey Aviation Co., Ltd., and Mr. A. Dunbar, managing director of Vickers-Armstrongs. Chairman of the Alloy Steels Emergency Committee is Mr. A. Matthews (Firth-Brown), and the members of this committee are: Mr. A. B. Winder (English Steel Corporation), Mr. G. Steel (S. Fox and Sons), Mr. L. Chapman (Wm. Jessop), Mr. S. G. Newton (Brown Bayleys), Mr. F. C. Harrison (Hadfields), Mr. H. Williams (Park Gate), and Major E. W. Senior (Ministry of Supply). The committee has full authority to deal with all questions relating to supply and disposition of these steels.

It is also announced that Lord Austin has retired from the chairmanship of the Shadow Aero Engine Committee, a position which he has filled with distinction since the committee was formed. Lord Austin is succeeded by Mr. W. E. Rootes.