arranged for horizontal mounting, is outlined. Here it will be noted that the exhaust gases are directed into the figure-of-eight which really comprises a passage of gradually decreasing cross-sectional area terminating in a nozzle which directs a curtain of high velocity exhaust gas across the entrance to the passage. This is in the same direction of flow as the main gas stream. The two limbs of the figure-of-eight encircle the two pipes by which the gases finally escape into the atmosphere. Gases entering the passage at ballistic velocity have a tendency, due to centrifugal force, to follow the outer walls of the passage and thus maintain the high velocity jet of exhaust gas which issues from the nozzle. At the same time, however, exhaust gas is discharged to atmosphere by way of the holes leading into the twin final exhaust pipes.

Unidirectional Flow

The pressure and velocity of the gases in the gradually decreasing passage ebb and flow as the respective cylinders exhaust, but the gas flow is always unidirectional, and any return surges of atmospheric pressure must first overcome the resistance of the nest of holes and cells around the exhaust pipes before they blend into the unidirectional gas stream. Their ability to destroy the depression in any one cylinder is further resisted by the curtain of gas emerging from the nozzles, which is maintained to the last, independently of the length of the exhaust pipes or the speed of the engine.

During this time the depression is extending through the combustion chamber and cylinder to the induction side of the engine, and a new charge of air, or combustible mixture, is flowing into the cylinder and may even reach the exhaust port and pipes, as is indicated by the pressure curves and port timing period lines in Fig. 5.

Furthermore, these remarks apply to a considerable extent to four-stroke engines, and the severe temperature stresses in the exhaust valves and combustion chamber may be considerably reduced, and the volumetric efficiency of the engine increased, by use of the figure-of-eight arrangement. In the control of the supercharged engine, the figure-of-eight acts in combination with the turbo-exhauster section of the turbine at low altitude. As the altitude increases the figure-of-eight is gradually cut out and the turbo-exhauster takes full control, in both two- and four-cycle engines.

A further method of altitude control is available by varying the pitch of the propeller blades on the compressor, and this may be the most useful since it is below exhaust gas temperatures. By these methods I have attempted to provide a solution to the problem of the simple, powerful and reliable aero engine, able to operate at high or moderate altitude. Such an engine could operate on volatile liquid fuel, either by fuel injection with spark ignition, or on the "pure-air rich mixture sandwich" system, or on high-flashpoint fuels by compression ignition.

Consider Figs. 6 and 7 as an aero engine for high-altitude work. It comprises six common combustion-chamber cylinders, without valves, in two opposed rams of three, with a total capacity of 4.2 litres.

The sleeve-valve engine owes its advantage chiefly to the absence of hot exhaust-valve heads, but this engine is free of all valves and all hot spots. Also, the rim of the turbine is effectively air-cooled, and everything makes for a cool-running, reliable power plant. Under these favourable

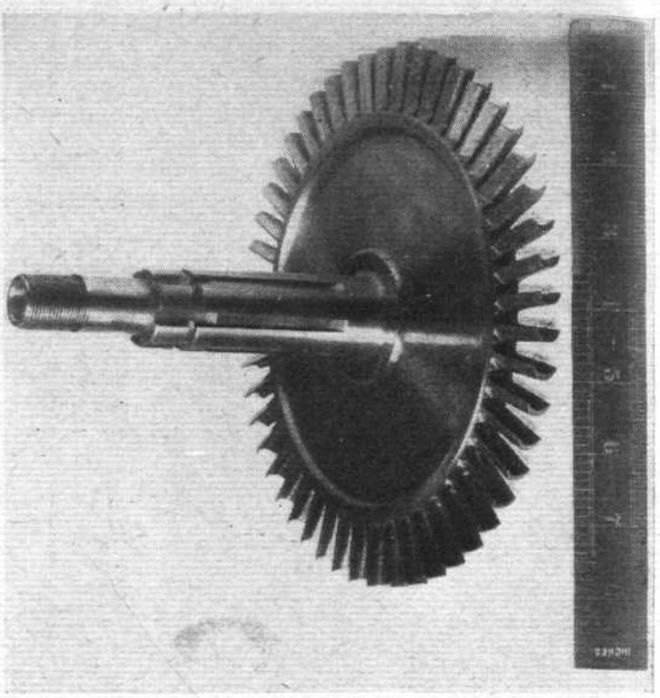

Fig. 12. A conventional type of turbo-supercharger turbine. This particular example was made from the solid in Hadfield's "Era" heat-resisting steel.

circumstances a power output of 336 b.h.p. at 3,700 r.p.m., with 2½ lb./sq. in. of supercharge, may be expected, that is, 80 b.h.p. per litre. This is equivalent to 4.7 b.h.p. per sq. in. of piston. These results almost equal results obtained by the N.A.C.A.† during their tests of a two-stroke engine, operating on the fuel-injection, spark-ignition system, using hydrogenated safety fuel. At a scavenge-supercharge pressure of 1 lb./sq. in., a B.M.E.P. of 130 lb./sq. in. was attained. At a pressure of 2½ lb./sq. in., 150 lb./sq. in. was attained, and the above results at 335 b.h.p. call for a B.M.E.P. of 140 lb./sq. in., and up to 9 lb./sq. in. supercharge pressure is available to give it (see Fig. 9).

As a compression-ignition engine its speed would be limited, by the operative speed of the fuel pump, to about 2,500 r.p.m., and the power output would be about 240 b.h.p. under the above scavenge-supercharge conditions. This would equal 57 b.h.p. per litre, with a B.M.E.P. of 128, and 3.37 b.h.p. per sq. in. of piston area. The more thoroughly a compression-ignition engine is scavenged, the smoother it runs and the higher the B.M.E.P. attainable.

The simple unsupercharged engine shown in Figs. 10 and 11 would be scavenged, but less power is to be expected. Here the power would be of the order of 185 b.h.p. at 2,500 r.p.m. (102 B.M.E.P., equal to 44 b.h.p. per litre, and 2.6 b.h.p. per sq. in. of piston). It is the ideal engine for light planes and commercial air transport.

I feel that it is only by working along these or similar lines that the powerful, light, and safe compression-ignition engine will eventuate.

† "Description and Test Results of a Spark Ignition and Compression Ignition, Two-Stroke Cycle Engine," by J. A. Spanogle and E. G. Whitney. N.A.C.A. Report No. 495.

APPEAL TO AIRCRAFT WORKERS

THE Minister for Aircraft Production, Lord Beaverbrook, made the following appeal last week to all aircraft factory workers:

"All employees of aircraft factories, aero engine works, factories making component parts for aeroplanes and plants engaged on sub-contracts for the air programme, are invited to work on Saturday and Sunday, May 26 and 26, and also on Saturday and Sunday, June 1 and 2. They are asked to work by night and by day, full overtime for the present. Any firm unable to follow this advice for any reason should send me a telegram, explaining the difficulties, and I will do what I can to smooth them out."

From reports which reach us it appears that the vast majority of factories responded magnificently to Lord Beaverbrook's appeal. As an example we may quote the factories under the control of Lord Nuffield. These will work seven days a week, and where material is available overtime will be worked by both day shifts and night shifts.

It is worth noting the proviso "where material is available." That is the all-important thing.