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MILITARY INTELLIGENCE DIVISION W.D.G.S.

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Military Attache Report Great Britain 16

Subject: Proposed Range of Gasoline Engine-Electric Power Units for Post War Development, Signals Research and Development Establishment. I.G. 8330.2202 MIG. 804-050

From: M.A., London Report No. R4689-46 Date: 6 November 1946

Source: Personal Conversations with Technical Staff of Signals Research and Development Establishment, 3 October 1946 A-2

Summary:

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1. The Signals Research and Development Establishment, (SRDE) Christchurch, Hants., after discussions with Signals 3, Directorate of Signals, War Office, have instituted a development program for a series of gasoline engine generating and charging units designed to give improved reliability and ease of maintenance, with longer operating life than that obtained with present units.

2. General details of the overall units, and specific requirements and details for the engines are given. Specific details on types of generators have not yet been formulated.

COMMENTS:

The Superintendent Engineer and Engineering staff of S.R.D.E. are widesmake and competent, and it is felt that their views on engines for postwar development will be interesting. A development contract has been let to Vincent H.R.D. Ltd. of Stevenage, Hertfordshire, who are well known as designers and manufacturers of lightweight, high-power motorcycle engines, in whom S.R.D.E. have full confidence.

Approved and forwarded

F. A. TATUM
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For the Military Attache:

S. N. DOW
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Distribution: Hr. & 1 cy to MIS: 1 cy to CSO: 1 cy to OCE: 1 cy to file

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1. As a result of [illegible] performance of gasoline engine generating and charging units during the recent war, especially with reference to the operating life between overhauls when leaded gasoline was used, the Signals Research and Development Establishment (S.R.D.E.), Christchurch, Hampshire, have instituted a development program for a new series of power units, six in number, using four different gasoline engines. Greater emphasis, at the moment, is being placed on the design of the engines, the major aim of which is to provide within the weight limitations, the most reliable and easily maintained units.

OVERALL DETAILS OF POWER UNITS

2. Appendix A, correct to 1 October 1946, gives overall particulars for the proposed new series of power units. They are to comply with the relevant clauses of Wireless Telegraphy Board Specifications K.114, most important features of which are the following tests which the equipment must pass:

a. Normal ambient temperature test, including test to full working life.

b. Drop test: (1) as a complete assembly to drop 6 inches on to a steel plate. (2) as a complete assembly but crated to drop 6 feet on to a steel plate.

c. Vibration tests with the equipment operative and non-operative on a vibration platform vibrating at a rate of between 10-100 cycles per second and at amplitudes varying between 0.005 and 0.025 centimeters.

d. Bump tests. The equipment will be subjected to not less than 4,000 bumps at a rate of 2-4 bumps per second with a minimum free drop of 1 inch.

e. High ambient temperature tests. The equipment will be required to operate at 55°C and to pass storage tests at 70°C.

f. High ambient temperature and high humidity tests. The equipment will be required to operate at 40°C, 95% relative humidity and at 55°C 85% relative humidity.

g. Low temperature and pressure operation. The equipment will be required to start and operate at ambient temperatures of minus 40°C and at pressures of 660 mm. of mercury.

h. Dust laden atmosphere test. The equipment will be required to operate in an atmosphere heavily laden with dust at ambient temperatures of 35°C and at 60% relative humidity.

i. The equipment will undergo a three month mould growth and storage test.

j. Additional tests to prove protection against driving rain, fire spray, salt water, and other corrosives such as war gases and decontaminants.

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ENGINES

3. Appendix B gives a table of detail requirements for the engines of the new series of power units.

a. In addition to being completely reliable between major overhauls and giving satisfactory and continuous operation under all conditions of M.T. Board Specification X.114 as outlined in para. 2 above, the engines will be required to operate on moving vehicles and work satisfactorily at all angles up to 15° from the horizontal.

b. Accessibility and ease of maintenance is an important requirement of design. Standardisation of parts within the range of engines is desirable but will not be allowed to conflict with the attainment of optimum design of each equipment for its particular duty.

c. Engines will be required to operate on standard motor transport fuels, i.e. gasoline up to 80 octane containing approximately 3-4 c.c. of tetraethyl lead per gal. (Br.); lubricants; and greases.

4. Negotiations have been carried on by S.R.D.E. with various engine manufacturers in an attempt to find a suitable company who would be willing to undertake the development of engines to meet the requirements as given above. Vincent H.R.D. Ltd. of Stevenage, Hertfordshire, was selected as the most suitable, and a development contract has been let to that company by S.R.D.E. on behalf of the Ministry of Supply. Vincent H.R.D. Ltd. or Vincent, Ltd., as it is sometimes known, is noted as the manufacturer of high power, lightweight, motorcycle engines, and has produced a very successful light marine engine of approximately 500 c.c. or 15 h.p. for the Admiralty during the war. The contract calls for work to begin immediately on as near simultaneous development as possible of the required engines. The extent of the contract is not definitely known, but it is believed to call for a maximum expenditure of approximately 10,000 pounds (B-3).

5. Appendix C is a brief statement of the ideas of the Vincent Company on the solution of the requirements, and indicates the line of development which they will follow. It will be noted that basically two types of engines are proposed: (1) For the extremely lightweight 100 and 500 watt sizes, a normal design, aircooled, overhead valve, four-stroke cycle type will be used. The 100 watt will be a single cylinder, while the 500 watt was proposed as a horisontally opposed twin cylinder. It is now thought, however, that within the specified maximum weight limits, it will be possible to effect a compromise between the relative powers required for the 100 and 500 watt sizes, and to make the 500 watt a three cylinder radial, using the same cylinders, pistons, etc. as the 100 watt, thus giving interchangeability of replacement parts between the two. (2) For the two larger engines of 250 c.c. and 1000 c.c. or 6-1/2 and 26 h.p. respectively a type of engine well known in theory but little encountered in practice is being considered. It is a liquid-cooled, double crankshaft, opposed piston, two-stroke cycle, with two firing cylinders and one charging cylinder for the 6-1/2 h.p. and four firing cylinders and twocharging cylinders for the 26 h.p. the cylinders being horisontal. Each charging cylinder contains two double-acting pistons, which provide the necessary sliding valve action and compression of fuel mixture for exhausting and charging the cylinders. The charging cylinder eliminates the use of crankcase compression, an evil which S.R.D.E. have specified must be avoided if possible. The two crankshafts are coupled together by a roller chain, from which a take-off sproket gives the output. This gives a convenient means of adjusting the shaft speed. These two engines are to be, in effect, scaled down and scaled up versions

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of a 13 hp. engine of the same type which was developed by Vincent, Ltd. for the Admiralty during the past war. The engine was developed for marine use, and has successfully passed all Admiralty tests, including 100 hours continuous running on 100 octane gasoline containing approximately 7 c.c. of tetraethyl lead per gal. (Br). The engine has a very clean design, lends itself well to splashproofing and waterproofing, and should be easily maintained.

GENERATORS

6. Details of the types of generators, control panels, charging panels, voltage regulators, etc. have not yet been formulated. S.R.D.E. are at this time contacting various firms in order to select a suitable one who is willing to undertake the development work.

7. Although the smaller 100 and 500 watt units call for D.C. output and the larger units for 50 cycle per second A.C. output, all types of generators will be investigated, including permanent magnet alternators, etc. As yet, no responsible authority will commit himself to the use of 400-2000 c.p.s. instead of 50 c.p.s. The use of the higher frequencies plus a dry disc rectifier will be considered for the two low power units instead of a D.C. generator.

8. A present requirement of the 50 c.p.s. units is that provision be made for and that conversion can easily be made to 60 c.p.s. operation for use with U.S. equipments requiring that frequency.

GOGGLETS

9. ENGINES: The engineering staff at S.R.D.E. have decided views against crankcase compression for any of the engines to be developed. They believe that reliability and ease of starting can be improved by avoiding it. They have confidence in and have issued a development contract to Vincent H.R.D. Ltd., of Stevenage, who have already developed for the Admiralty a practical, 2-stroke cycle engine using a charging cylinder instead of crankcase compression. The engine looks promising from many points of view: reliability, ease of maintenance, operating life on leaded fuels, ease of splashproofing and waterproofing, and general cleanness of design. Detailed results of the Admiralty tests upon this engine can be obtained if desired.

10. GENERATORS: Details of the electrical side of the power units are not yet decided upon. They will be forwarded as available.

11. This report has been coordinated with the Engineer Liaison Officer of this Office, and will be of interest to the Corps of Engineers. A copy of the report is marked for distribution to the Office of the Chief Engineer as well as to the Office of the Chief Signal Officer.

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APPENDIX "A"

PARTICULARS OF PROPOSED RANGE OF CHARGING AND CHARGING SETS, (OCTOBER 1946)

Rating and Output	Transport	Weight & Dimensions	Output Control	Aimed life in hours between Engine overhauls	Gasoline Consumption in hours/gall at full load	Remarks
100 watts @ 12V. D.C. 50 watts @ 6V.	Manpack or Vehicle	25 lbs. 13" long 14" high 8" wide	Throttle and field Reg.	200 Minor 1000 Major	56 hours	Weight of 25 lbs includes complete unit with chargin, switchboard, oil tools and spares, less fuel, ready for attaching to Carriers (Packboard) G.S. to be dropped in kit-bag with man.
500 watts @ 24V. D.C. 250 watts @ 12V.	Mulepack or Vehicle	80 lbs. 28" long 12" high 18" wide	Throttle and Field Reg.	400 Minor 2000 Major	7 hours	Weight of 80 lbs. includes complete unit with charging switchboard, oil, less tools, spares and fuel, ready for mule transport. In Mule Station these items with spare oil and fuel will be carried on other side of mule. Tools and spares to stow in unit for vehicle use. At a later date, a 60 cycle 240V. unit may be designed for this Set.
3000 watts 240V. 50 cycle A.C.	Light trailer 1/2 ton or vehicle	250-300 lbs. 35" long 19½" high 24" wide	Auto Volt Reg. plus or minus 5%	500 Minor 3000 Major	1-1/2 hours	Weight is exclusive of Starter Battery and Tools and spares. Tools and spares to stow in unit for vehicle use. Socket outlet with A.C. Metering and Control.
2500 watts @ 40V. D.C.	ditto	ditto	Field Reg.	500 Minor 3000 Major	1-1/2 hours	ditto Includes charging switchboards
10,000 watts 240 V. 50 cycle A.C.	Heavy trailer or vehicle	A. weight 2240 lbs. 120" long 60" high 54" wide	Auto volt Reg. plus minus 5%	500 Minor 3000 Major	1/2 hour	Normally towed by 8 ton or other lorry but to be satisfactorily towed by British jeep. Complete with tools and spares, spare fuel and oil, and with cable and switchboard stowage. Dimensions A. complete in Trailer B. - Unit only. Socket outlet with A.C. metering and control.
10,000 watts probably 120V. D.C.	Heavy trailer or vehicle.	B. weight (dry) 1500 lbs. 60" long 30" high	Field Reg.	500 Minor 3000 Major	1/2 hour	ditto Excludes charging switchboard

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APPENDIX "B"

TABLE OF PARTICULAR REQUIREMENTS FOR A RANGE OF ENGINES FOR GASOLINE ELECTRIC GENERATORS

Generating Set Rating Watts	Engine Shaft H.P. Approx.	Max. Engine Weight lbs. *	Output Shaft Speed R.P.M.	DIMENSIONS OF ENGINES Length Inches	Height Inches	Width Inches	LIFE BETWEEN OVERHAULS IN HOURS Major***	Minor****	SPEED CONTROL
100	3/8	9	4,000	7	10	8	1,000	200	Manual Throttle
500	1½	25	2,500 -3,000	14	10	18	2,000	400	Governor to plus or minus 5% may be required.
2,500	6½	95	1,500 -3,000	18	18	24	3,000	500	Governor to plus or minus 2½.
10,000	26	850**	1,500	22	30	36	5,000	500	Governor to plus or minus 2%.

* Weight includes oil carburetor, ignition system and cooling system, less fuel tank and fuel.

** Less radiator

*** Major overhaul is defined as a complete strip with replacement of all wearing parts and others as necessary.

**** Minor overhaul is that which can be undertaken by relatively unskilled personnel - it includes combustion space cleaning but the minimum and simplest replacement of parts.

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Owing to the somewhat differing major requirements, mainly lightness in the 100 Watt and 500 Watt sizes and longevity in the 2,500 and 10,000 Watt sizes, it has been considered desirable to submit two basic forms of engine, the general description of each type to be substantially as follows:

100 Watt:
25 c.c., air-cooled, single cylinder, O.H.V. four-stroke, with aluminium-bronze cylinder head, hardened steel barrel, anodized aluminium full-skirted piston, high-strength light alloy connecting rod with solid big-end running direct on Nitralloy crankpin.

Major castings of magnesium alloy if absolute minimum weight is required, or non-corrodible anodised aluminium alloy to Spec. D.T.D.546 or equivalent, if maximum sea-water resistance is more important.

Lubrication by mechanical pump on the total-loss system, avoiding necessity for oil filter, valve-gear totally enclosed and lubricated.

If design of generator permits, engine could be bolted direct to generator end-cover, with crank directly attached to armature spindle which, if suitably strengthened and carried in adequate bearings, would then form the crankshaft.

Ignition by H.T. magneto, unless a flywheel type of magneto of lighter weight could be devised.

500 Watt:
125 c.c., air-cooled, O.H.V. horizontally opposed twin cylinder four-stroke, with aluminium heads and inserted austenitic castiron valve seats, hardened steel barrels, aluminium full-skirted pistons, high-strength aluminium alloy connecting rods with split big-ends, nickel-chrome molybdenum alloy cast iron crankshaft with hardened journals.

Main castings either in magnesium alloy or non-corrodible anodised aluminium alloy, according to whether minimum weight or maximum sea-water resistance is required.

Lubrication by pressure feed by pump from oil tank in ribbed sump, valves and valve-gear totally enclosed and lubricated by splash or separate feeds.

Ignition by H.T. flywheel or separate magneto.

Speed control by "Isospeedic" governor if required.

Air-cooling has been put forward on the engines already mentioned for lightness and ability to operate at any temperature without necessity for draining off the emission of vapour which may be visible to an enemy.

The four-stroke cycle is proposed because it would appear to be difficult to get a three port-two-stroke to operate for the required minimum duration.

O.H.V. are suggested to minimise barrel distortion under excessive air temperature conditions.

On the larger sizes, where weight and bulk are less important, but the required life is longer, we suggest the following types:-

2,500 watt size:
250 c.c. liquid-cooled double crankshaft opposed-piston two-stroke, with two firing cylinders and one charging cylinder with two double-acting pistons as per our British Patent No.565974.

Full pressure feed lubrication through full flow filter to all bearings, including small ends and pistons, which will have oil-cooled crowns as per our British Patent No. 562124.

Cylinder block of anodized non-corrodible aluminium alloy, with inserted dry liners of cast-iron or nitrogen-hardened steel for maximum abrasive resistance.

Four bearing hollow crankshafts in nickel-chrome molybdenum castiron with hardened journals, coupled together by duplex roller chain with hydraulically controlled tensioner sprocket; exhaust crankshaft set with approximately 20° lead over transfer shaft to provide port-timing giving maximum economy.

Steel-backed renewable shells to all big-end and main bearings.

Oil contained in sump under cylinder block, and cooled by internal water-circulating coils.

Ignition by screened H.T. magneto with impulse starter.

Speed control by "Isospeedic" governor on throttle.

10 K.W. size
1,000 c.c. liquid-cooled double crankshaft opposed-piston two-stroke, with four firing cylinders and two charging cylinders each with two double-acting pistons; the engine to be substantially an enlarged duplicate of the 250 c.c. size engine as regards cycle of operations, materials and general construction.

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