KCBraun
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Using Aromatic High Test Fuels
in Place of B4

Ludwigshafen, 19 January 1942
(See also T-376 & T-378)

B4 is the aviation fuel used in civil aviation up to the present time and is still largely used today in military aviation, with an octane number (motor method) of 87 to 90.

C3 is the high test fuel (Hochleistungskraftstoff) frequently used today in our pursuit planes, composed of 80%/vol. aromatic gasoline from bituminous coal or pitch (CV_2b or VT 706b), 20%/vol. ET 110 and 0.12% tetraethyl lead.

If DHD gasoline from bituminous coal is used in place of CV_2b for making the fuel mixture, we obtain the high test fuel C2 with still better anti-knock properties. Fuels C3 and C2 contain about 40%/vol. aromatics.

C1 corresponds to the present foreign 100 octane high test gasoline, composed of about 50%/vol. iso-octane plus iso-pentane, 50%/vol. 87 octane gasoline (Borneo quality), and 0.12% tetraethyl lead.

Table I shows the mean effective pressure (Nutzdruck) (p_{me} in atm) obtainable in a BMW one-cylinder overload motor with the various fuels, which are a direct measure of the motor power obtainable. In the experiments, at a charged air temperature of 130° C and a compression ratio of 1:6.5, the load pressure was increased so long until the knock limit (Klopfgrenze) was reached.

If the motor power obtainable with B4 is set at 100%, an improvement in power of about 50% is obtained with C3 under starting conditions ($\lambda \approx 0.8$, corresponding to 20% excess fuel), with C2 even 75%, but only about 20% with C1. The aromatic high test fuels are far superior to the iso-paraffinic C1, particularly with rich fuel-air mixtures, as may be seen from the table. The increase in power obtainable in a motor is naturally dependent not only on the fuel but also on a large number of other factors, particularly of construction, such as good cooling of the piston, the valves and the cylinder head.

If greater power is obtained with a better fuel, this gain in power can be utilized to increase the speed of the plane and its climbing ability. The plane speed rises about as the cube root of the motor power. If, for example, we have a plane with a max. speed of 500 km/h and we increase the motor power by 75%, we increase the flying speed by about 20% to 600 km/h. Increasing the motor power by 20% increases the speed by 6%, or to 530 km/h.

Under certain conditions, the higher heat value per liter of the aromatic fuels, compared to iso-paraffinic, can be of special advantage. This is particularly so with very fast planes, where the question of space is of greater importance than that of weight.

TABLE I

Overload Experiments on BMW One-Cylinder Motor
(From experiments at the Tech. Test. Sta.-Oppau)

Fuel	Starting $\lambda = 0.8$		Climb & Combat Power $\lambda = 0.85$		Continuous Power (Dauerleistung) $\lambda = 0.95$		Min. of Overload Curve $\lambda = 1.1$	
	m.e.press. p_{me}	power %	m.e.press. p_{me}	power %	m.e.press. p_{me}	power %	m.e.press. p_{me}	power %
B4	12.1	100	11.5	100	9.8	100	8.2	100
C3	18.5	153	17.7	154	15.0	153	11.3	138
C2	21.6	178	20.4	177	17.5	178	13.4	163
C1	14.3	118	13.8	120	12.5	128	11.1	135
CV_2b	19.6	162	18.6	162	15.0	153	10.5	128
DHD from Bit. Coal	23.2	191	22.0	191	18.2	186	13.0	159

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