



## ILLUSTRATIONS for Appendix 7

**Fig. 1**  
**PEP 337**

**1926 Velocette Mk. 1 Junior TT**  
Vertical 1 a/c 74 mm/81 = 0.914 348 cc  
20 HP @ 5,500 RPM

This was the 1<sup>st</sup> overhead camshaft engine  
to win a TT, with Alec Bennett riding.

DASO 193



**Fig. 2**  
**SO 10**

**1930 Rudge-Whitworth Senior TT**  
Vertical 1 a/c 85 mm/88 = 0.966 499 cc  
34.2 HP @ 5.900 RPM

The 500 cc Rudge won the Senior TT at record speed, with  
Walter Handley riding. He did the 1<sup>st</sup> under-30 minute lap  
of the Isle of Man Mountain circuit (76.28 MPH).

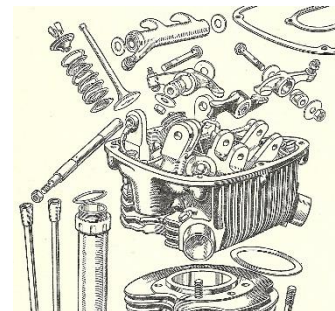
See also "Significant Other" at SO 10.

[www.thevintagent.blogspot.com](http://www.thevintagent.blogspot.com)



At RHS the PROHV gear of the engine is  
shown. There were 3 rockers to operate  
the radial exhausts.

DASO 73



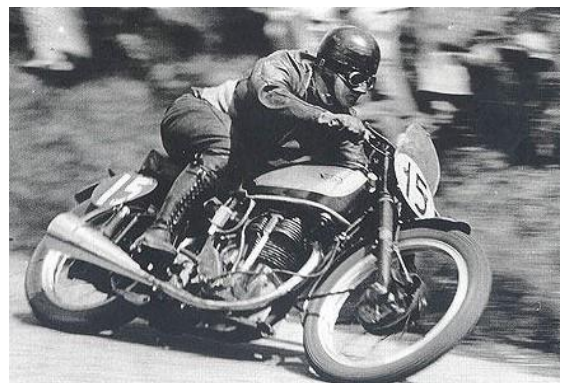
**Fig. 3**  
**SO 12**

**1938 Norton Senior TT**  
Vertical 1 a/c 82 mm/94.3 = 0.870 498 cc  
49 HP @ 6,750 RPM

Harold Daniell, seen here, won the Senior TT with  
a record last lap at 91.00 MPH.

See also "Significant Other" at SO 12.

DASO 74

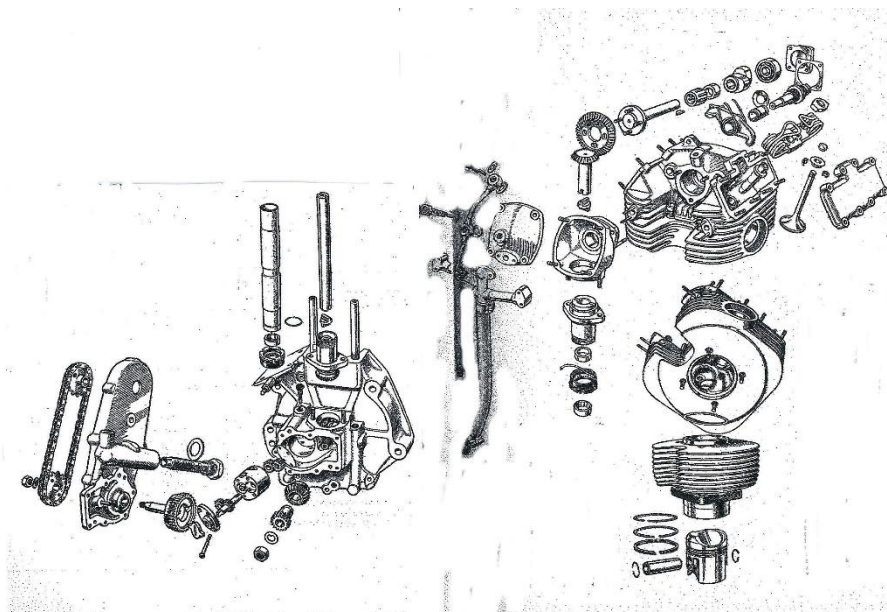


The huge "megaphone" (exhaust diffuser) is notable.

**Fig. 4**  
**PEP 204**  
 1939 Velocette  
 Mk VIII Junior TT  
 Vertical 1 a/c  
 $74 \text{ mm}/81 = 0.914$   
 348 cc  
 29 HP @ 7,500 RPM

This model, made for sale, was similar to the "works" machines which won the Junior TT in 1938 and 1939, ridden by Stanley Woods.

DASO 73

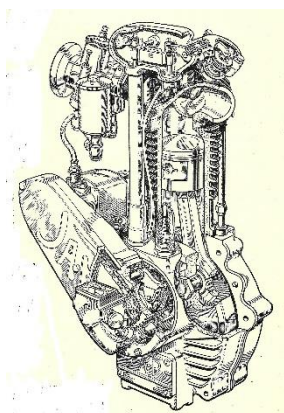


The large area of finning was needed to take it outside the dead area behind the front wheel. The "works" engines had even larger fins.

**Fig. 5**  
**PEP 206**  
 1939 Excelsior Manxman 350  
 Vertical 1 a/c  $75 \text{ mm}/79 = 0.949$  249 cc  
 22.5 HP @ 6,000 RPM



bonhams.com



**Fig. 6**  
**PEP 311**  
 1947 JAP Speedway  
 Vertical 1 a/c  $80 \text{ mm}/99 = 0.808$  498 cc  
 38 HP @ 6,000 RPM

DASO 73

Speedway racing was introduced into the UK from Australia in 1928. At first Douglas twins and Rudge singles were used. In 1930 a leading English rider, Wal Phillips, used the new JAP engine (initially giving 33 HP @ 6,000 RPM on alcohol) so successfully that the JAP soon became the standard speedway unit for 40 years. Phillips used the engine to lap Brooklands at over 100 MPH. The Speedway JAP also powered most of the post-WW2 500 cc formula cars, until superseded by the DOHC "Manx" Norton in the '50s

Contd. on P. 3



Contd. from P. 2

Col. I, PEP 435, the JAP RR Mk 1 was a lighter and better cooled development of the Speedway JAP especially for 500 cc cars. It had Al-alloy cylinder finning. However, as remarked, this engine was overtaken by Norton engines in 1950, at least for the longer races. The JAP must have been much cheaper, because Norton would not supply their engines separately and those wanting such a unit had to buy the whole bike!

Fig. 7

PEP 178

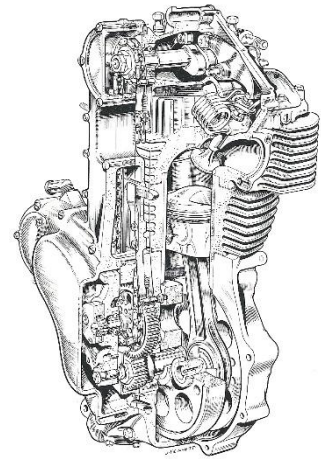
1951 AJS 7R

Vertical 1 a/c 74 mm/81 = 0.914 348 cc

34.5 HP @ 7,000 RPM

Like the KTT Velocette and the "Manx" Nortons the 7R was built down to a price for the private rider. The bike sold for £324 in 1951 (equivalent to £9,000 in 2016 money). In its debut year of 1948 a 7R ridden by Geoff Murdoch finished 4<sup>th</sup> in the Senior TT at 92% of the winning 500 cc speed. The first major successes were by Bob McIntyre in winning the 1952 Junior Manx GP and coming 2<sup>nd</sup> in the Senior GP.

DASO 193



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Fig. 8

PEP 222

1952 Norton Senior  
Manx

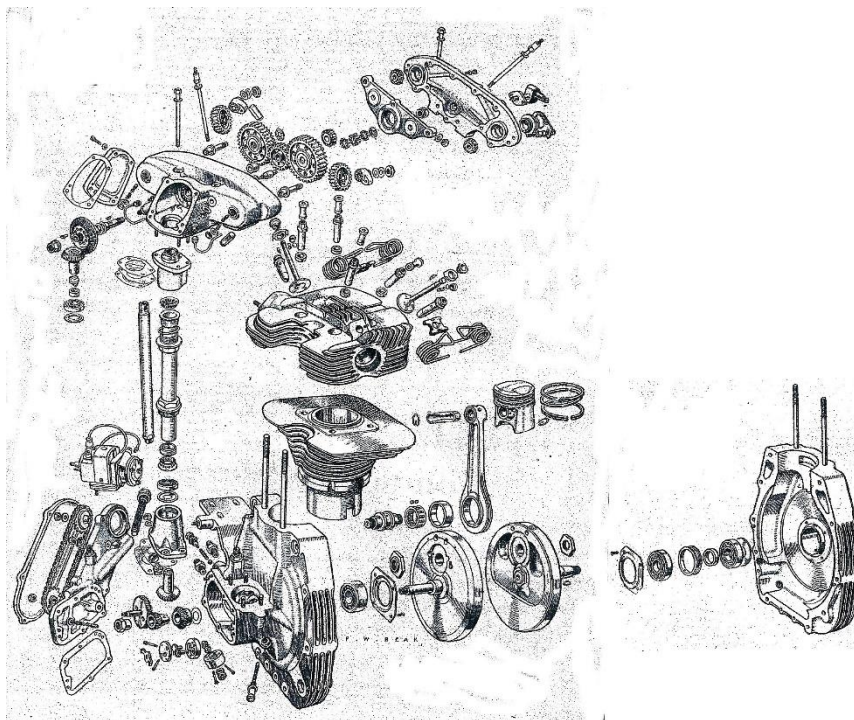
Vertical 1 a/c

79.62 mm/100 = 0.796

498 cc

37.5 HP @ 6,000 RPM

The classic Norton 500 cc dimensions were 79/100 for 490.2 cc up to 1935. In that year the Senior "works" bike was beaten in the Isle of Man by 4 seconds – 0.04% !. This led to the boring-out in 1936 to 79.62 to give 497.9 cc, an increase of 1.6% which would yield extra power for about



+0.3% lap speed.

DASO 85

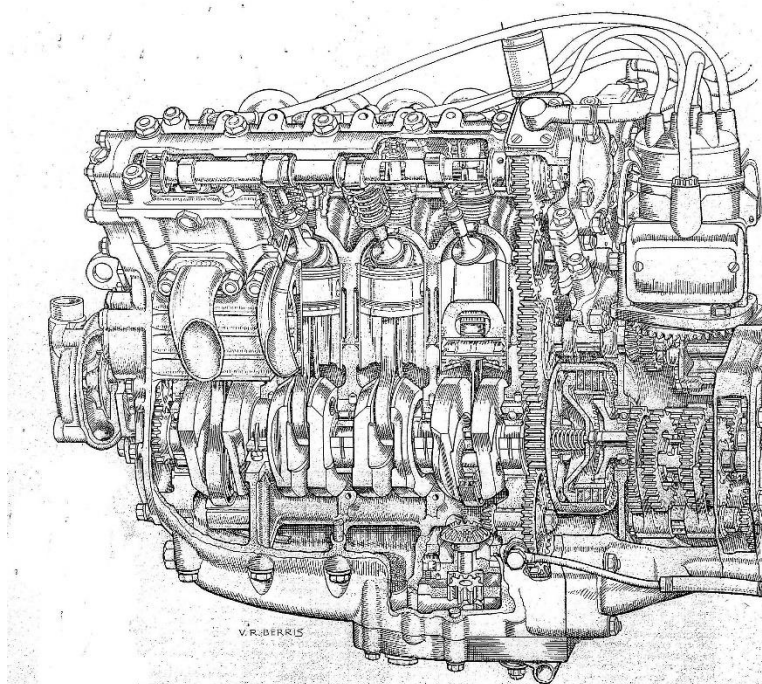
The "Manx" machines (Senior and Junior (Col. K, PEP 223)) were made for sale to private owners.

Fig. 9

PEP 238

1953 Moto Guzzi Four  
Longitudinal IL4 water-  
cooled 56 mm/50 = 1.130  
493 cc  
61 HP @ 9,000 RPM

This unusual design is reported to have been produced outside the Moto Guzzi works by Carlo Gianini {see [www.italianways.com](http://www.italianways.com)) It won only one major race, on the fast circuit at Hockenheim in May 1953, ridden by Enrico Lorenzetti. This did not count towards the World Championship. It was too unwieldy for twistier circuits.



Both figs DASO 93

The scrap section illustrates the valve gear.

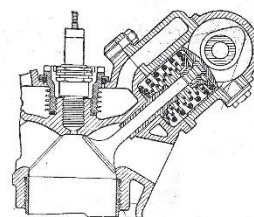


Fig. 10

PEP 287

1954 BSA Gold Star  
Junior Clubman's TT  
Vertical 1 a/c  
71 mm/88 = 0.867  
348 cc

32 HP @ 7,000 RPM

The Gold star, in various versions, won the Junior Clubman's TT for 8 years in a row, from 1949 to 1956, until the race was discontinued.

DASO 342

DASO 462

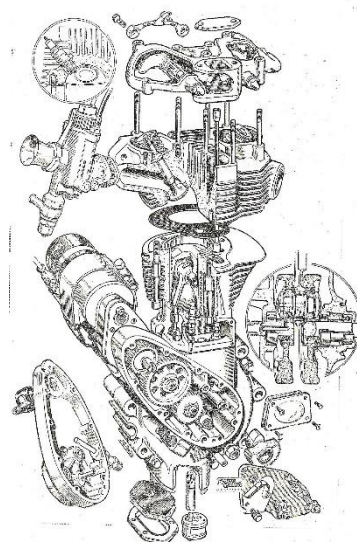
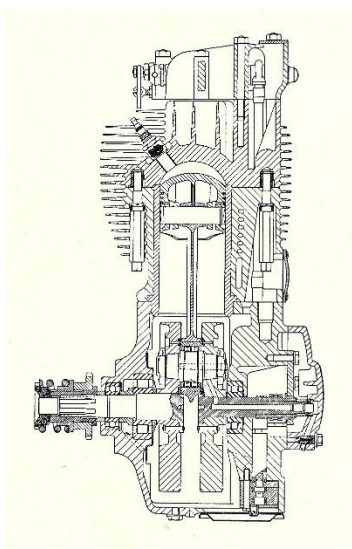


Fig. 11

PEP 286

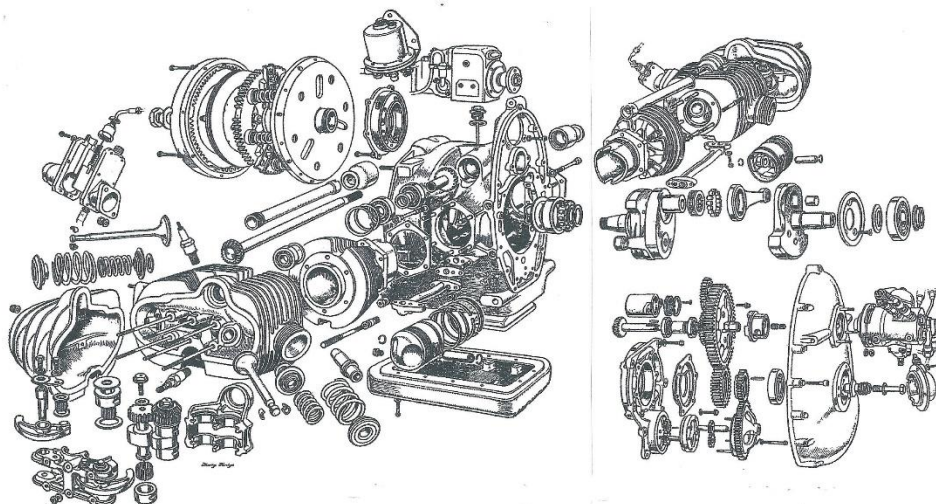
1954 BMW RS

Opposed Flat2 a/c 66 mm/72 = 0.917 493 cc  
58 HP @ 9,000 RPM

The NA BMW 500 cc flat twin never won a solo TT but powered the winning Sidecar race 13 times, from 1955 until that capacity was discontinued after 1968, with the exception of a BSA-powered win in 1962. When the Sidecar race was run for 750 cc machines the similar F2 BMW (82 x 70.6 ?) won 6 years consecutively, from 1969 to 1974. The most successful driver was Siegfried Schauzu with 9 wins. Contd. on P. 5



Contd. from P.4



DASO 194

In sidecars the width and frontal area of the horizontally-opposed flat twin engine was not the handicap which it was in solo bikes. Port fuel injection was introduced in 1953.

Fig. 12

PEP 630

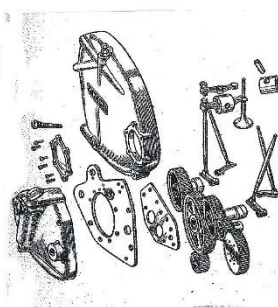
1954 Vincent Black Shadow

Fore-and-Aft 50V2a/c

84 mm/90 = 0.933 998 cc

55 HP @ 5,700 RPM

The figure is a "Rapide" model, which was similar.



DASO 73

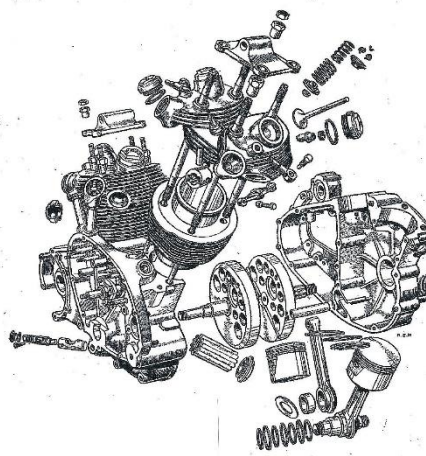
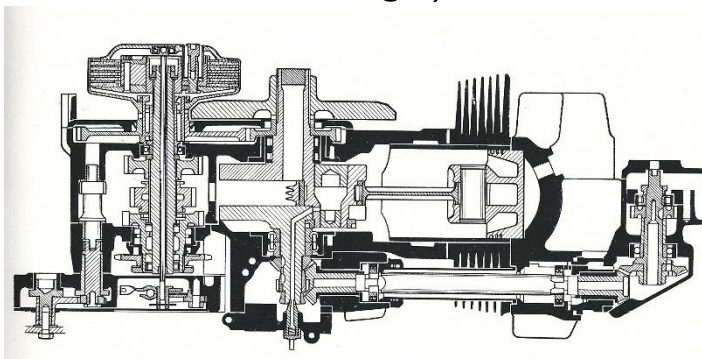


Fig. 13

1955 Norton F-type

Horizontal 1 a/c 90 mm/78.4 = 1.148 499 cc

55 HP @ 7,600 RPM



DASO 1104

Although the head finning was changed to suit the new cooling airflow direction, as can be seen the barrel finning was not, which is strange.

This flat engine was intended for the 1955 season but the AMC company which owned Norton withdrew from a full "works" participation of Norton and AJS at the end of 1954. Norton did make various experimental vertical singles over the next few years, including one with desmodromic valve gear in 1959.

Fig. 14

PEP 237

1957 Moto Guzzi 350

Horizontal 1 a/c 75 mm/79 = 0.949

349 cc

42 HP @ 8,000 RPM

Moto Guzzi over 1921 to 1957 tried more motorcycle engine configurations than anyone else, ranging from singles to V8, normally aspirated and, pre-WW2, supercharged. However, their most steady success was with horizontal singles in the 250 and 350 cc classes. They won the 250 cc World Championship in 1949, 1951 and 1952. Enlarged from the 1952 machine the 350s won their Championship from 1953 to 1957, after which the firm withdrew from racing.

DASO 92

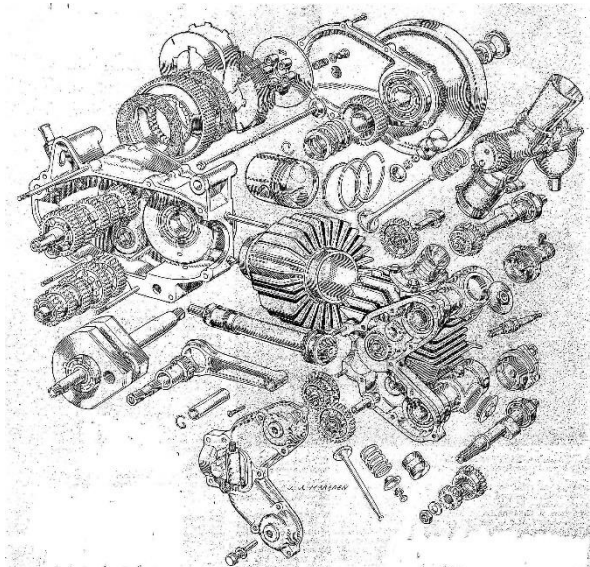


Fig. 15

PEP 239

1957 Moto Guzzi

Eight

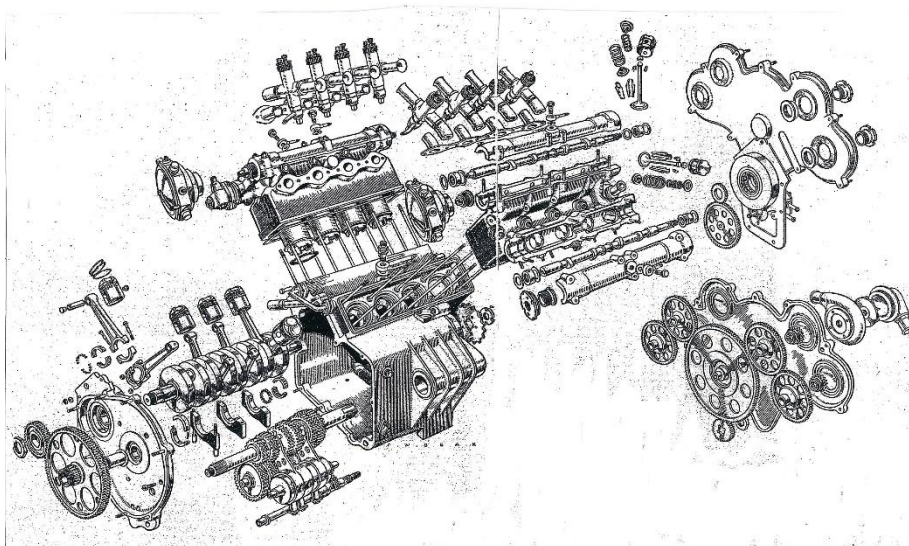
Transverse 90° V8 w/c

44 mm/41 = 1.073

499 cc

80 HP @ 12,000

RPM



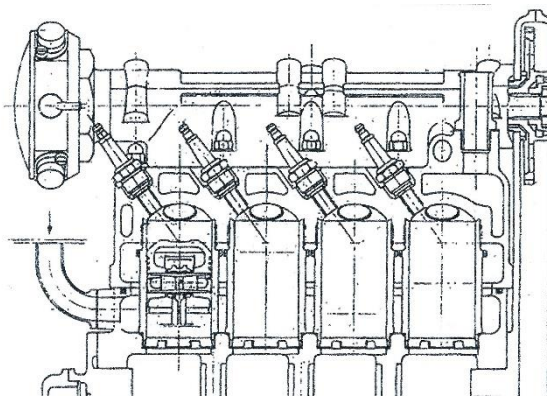
This engine first appeared in a race in Spring 1956 and over the next few months showed great speed

but little reliability – not surprising in its first year. In early 1957 It won two non-Championship Italian races. Its best result in a Championship race was 4<sup>th</sup> place by Dickie Dale in the 1957 8 lap Silver Jubilee TT, finishing on 7 cylinders. The retirement of Moto Guzzi at the end of the year left its great potential unachieved.

DASO 94

RHS is a section of the  
V8 Guzzi.

pinterest.com



The Moto Guzzi Eight was really ahead of tyre development and its ability to rev. at a great rate if adhesion was minimal probably contributed to crashes by Fergus Anderson and Keith Campbell.



**Fig. 16**  
**SO15**  
**1962 AJS 7R**  
**Vertical 1 a/c 75.5 mm/78 = 0.968**  
**349 cc**  
**42 HP @ 7,800 RPM**

See also **"Significant Other"** at SO15.



wikipedia



deejay51

**Fig. 17**  
**SO18**  
**1965.5 Honda RC149**  
**Transverse 5 a/c 35.5 mm/25.1 = 1.414**  
**124 cc**  
**32.7 HP @ 20,000 RPM**

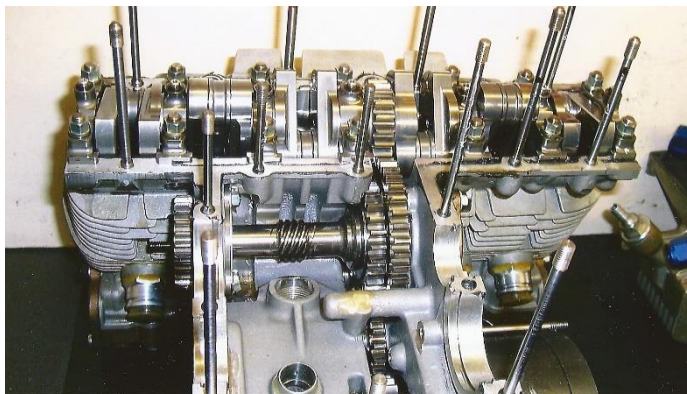
See also **"Significant Other"** at SO18.

**Fig. 18**  
**1966.5 Honda RC174**  
**Transverse IL6a/c 41 mm/37.5 =**  
**1.093 297 cc**  
**68 HP @ 15,500 RPM**

On the RC174 Mike Hailwood won 6 of the 8 races in the 350 cc Riders' Championship, despite giving away 15% of permitted capacity. Ralph Bryans on another Honda 6 won a 7<sup>th</sup> race.



vintagebike.co.uk



**LHS shows the crankcase of a replica**  
**RC174 produced by George Beale.**  
**Photographed by his courtesy.**

Fig. 19

PEP 374

1970 Triumph Trident T150/ BSA Rocket 3

Transverse IL3a/c 67 mm/70 = 0.957 740 cc

58 HP @ 7,250 RPM



beardinthewind.blogspot.com

A Trident ("Slippery Sam") prepared for the Production TT won that I o M class for 5 years running, 1971 – 1975, with several different riders. Developed for racing (with a special frame) the engine produced 84 HP @ 8,250 RPM and won the 1971 Daytona 200 with Dick Mann and the I o M Formula 750 in 1972, ridden by Ray Pickrell (Wikipedia).

Fig. 20

PEP 240

1972 Ducati 750SS

Fore-and-Aft

90V2a/c

80 mm/74.4 =

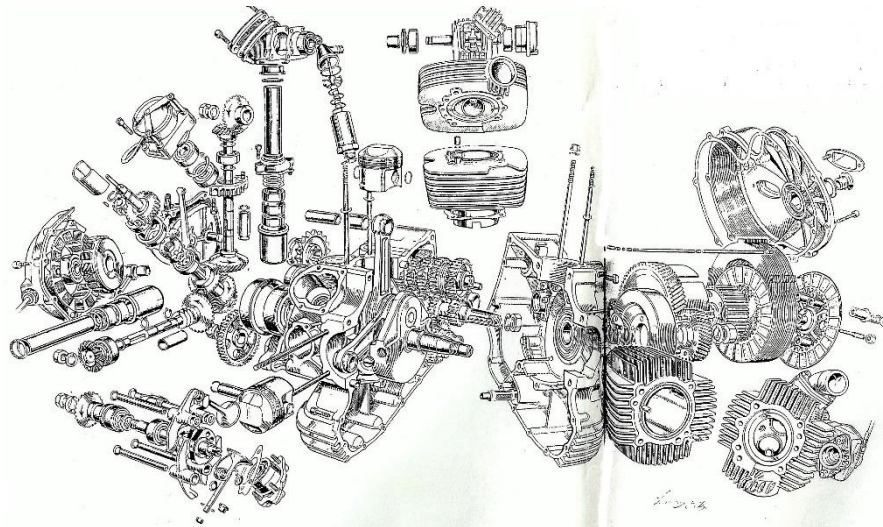
1.075 748 cc

94 HP @ 8,800

RPM

Paul Smart won the 1972 Imola 200 with the 750SS with another Ducati 2<sup>nd</sup>.

DASO 95



classicspeedwaysandgrasstrack.com

Fig. 21

PEP 315

1974 Weslake WR275

Vertical 1 a/c 86 mm/86 = 1 499 cc

60 HP @ 7,000 RPM

The JAP engine (see Fig. 6) had been displaced for Speedway racing by the Czech Jawa, also a vertical 1 a/c with 2 valves per DASO 95cylinder. In late 1974 the 4 v/c Weslake made its debut and was seen

immediately to be superior to the Jawa. The leading British rider Peter Collins changed to the new engine in 1975 and won the World Speedway Championship.



Fig. 22

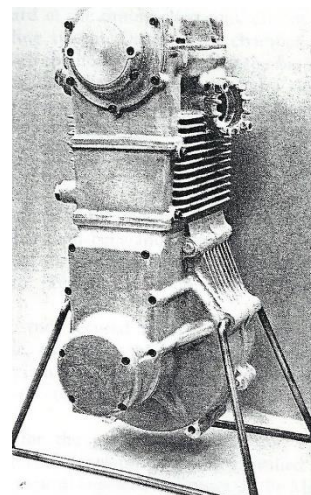
PEP 253

1983 Godden GR500 Mk. 4

Vertical 1 a/c 85.5 mm/86 = 0.994 494 cc

64 HP @ 8,250 RPM

Don Godden, a very successful grass-track competitor and frame maker, had been involved with the creation and later sales of the Weslake engine (see Fig. 21). He then decided in 1978 to build his own engine, going one step further than the PROHV 4 v/c Weslake engine by having SOHC to operate its 4 v/c. Various Marks followed. Major successes included Hans Nielsen winning the World Speedway Championship in 1986 and 1987 and 2<sup>nd</sup> in 1988.



DASO 95

Fig. 23

PEP 245

1983 Suzuki XR69

Transverse IL4 a/c 70 mm/64.8 = 1.080

998 cc

134 HP @ 9,500 RPM



disturbingthe peace.com

The XR69 engine was developed with the aid of the American tuner "Pops" Yoshimura. The bike had great success over the years 1980 -1984. This included winning the Classic TT four times running:- 1981 (Graeme Crosby); 1982 (Dennis Ireland); 1983 and 1984 (Rob McElnea).

Fig. 24

PEP 406

1988 Honda VFR750

Fore &amp; Aft 90V4 w/c 70 mm/48.6 = 1.440 748 cc

106 HP @ 11,250 RPM



e-bay.co.uk



Fig. 25

PEP 299

1991 Kawasaki ZXR750R

Transverse IL4 w/c 71 mm/47.3 = 1.501

749 cc

145 HP @ 13,500 RPM

e-bay.co.uk

Fig. 26

PEP 292

1995 Ducati 916

Fore & Aft 90V2 w/c 96 mm/66 = 1.455 955 cc  
154 HP @ 11,200 RPM

The Figure shows the engine partly stripped to replace the camshaft driving belts.

tassel.co.uk



Fig. 27

PEP 462

1996 Suzuki GSXR750

Transverse IL4 w/c 72 mm/46 = 1.565 749 cc  
124 HP @ 11.800 RPM

Fig. is of a 1998 engine.



e-bay.com

Fig. 28

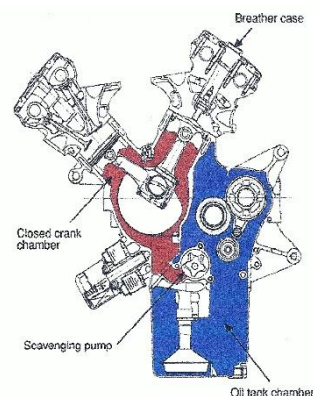
2002 Honda RC211V

Fore & Aft 75.5V5 w/c 72 mm/48.6 = 1.481 989 cc  
220 HP @ 14,000 RPM

The 2002 RC211V won 14 out of 16 4-stroke 990 cc races in the 1<sup>st</sup> MotoGP Championship (Valentino Rossi 11; Alex Barros 2; Tohru Ukawa 1).

See also "[Grand Prix Motorcycle Engine Development, 1949 - 2008](#)" and "[Corrections](#)" at 8 October 2015.

DASO 1130



[The original print of this engine was distorted and it was not possible to correct this completely.]



robstravels.com

Fig. 29

2004 Yamaha YZF-R1

Transverse IL4 w/c 77 mm/53.6 = 1.437 998 cc  
172 HP @ 12,500 RPM



**Fig. 30****2007 Ducati 1098**

Fore & Aft 90V2 w/c 104 mm/64.7 = 1.607 1099 cc  
160 HP @ 9,750 RPM

Troy Bayliss won the 2008 World Superbike Championship with a Ducati 1098 tuned for racing. To take full advantage of the FIM WSB rule allowing Vee-twins up to 1200 cc, Ducati for 2011 produced the 1198R of 106 mm/67.9 = 1.561, 1198 cc giving 180 HP @ 9,750 RPM. Carlos Checa won the WSB championship on this machine (Wikipedia).



motorcyclenews.com

**Fig. 31****2009 Kawasaki ZX-6R**

Transverse IL4 67 mm/42.5 = 1.576 599 cc  
108 HP @ 14,000 RPM

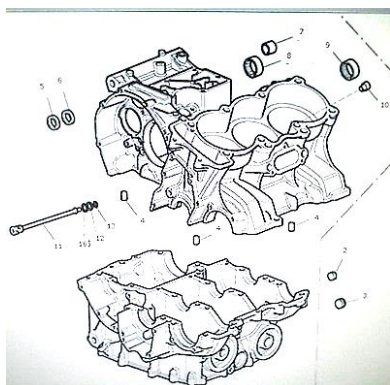
Figure is for a 2005 ZX-6R which was similar, no clear picture being available for the 2009 model.



motorcycle-usa.com

**Fig. 32****2011 Triumph 675R**

Transverse IL3 w/c 74 mm/52.3 = 1.415 675 cc  
124 HP @ 12,600 RPM



Both figures motorcycle.loc8apart.co.uk

**Fig. 33****2012 Honda CBR1000RR Fireblade**

Transverse IL4 w/c 76 mm/55.1 = 1.379 999 cc  
148 HP @ 10,700 RPM

Over the period 2008 to 2012 this model of the CBR1000RR won 9 out of 10 major TT races (Superbike, Senior and Superstock), ridden by John McGuinness (6), Ian Hutchinson (2) and Steve Plater (1).



danosperformance.com

Fig. 34

**2012 BMW S1000RR****Transverse IL4 w/c 80 mm/49.7 = 1.610 999 cc****193 HP @ 13,000 RPM**

**The race-tuned version of the S1000RR produced 220 HP @ 14,000 RPM. Ridden by Michael Dunlop it won the Superbike, Superstock and Senior TTs in 2014 and the Superbike and Senior TTs in 2016. In the last race Dunlop set a new Isle of Man Mountain lap record of very-nearly 134 MPH.**

7-forum.com

