Background: - The TR2-4A Engine has strong links with the engine used in the Ferguson post war tractors which were manufactured for Ferguson by The Standard Motor co. This document prepared by Ian Cornish was first published in the TR Register club magazine, TR Action. Ian has given Revington TR permission to publish the article as an Information sheet so that it may reach a wider audience.

Eagle eyed readers will notice my initials at the bottom right of drawing H2 but also a little legend 7 which was my way of identifying that I did the drawing in 1976. Positively aggggesss ago! Neil Revington.

WHENCE CAME THE TR's 4-POT ENGINE?

Ian Cornish

Published in TR Actions 241 & 242 (March & May 2010)

Standard's "Shadow" Factory

In 1939, at Banner Lane, Coventry, the Standard Motor Company commenced the construction of a new, "shadow", factory and this was in operation in 1940, making aero engines. Shadow factories were built away from the existing factories in order to reduce the risk of damage from air raids, from which Coventry, as an industrial centre vital to the War effort, later suffered very heavily. This 1,000,000 square feet (93,000 square metres) plant stood idle once the war had ended, and Standard's Managing Director, Sir John Black, was anxious to find a use for it. Such a large empty factory was also of interest to Harry Ferguson, and a deal was struck between the two men.

After the War was over

It must be remembered that the day after Victory in Europe Day (the War ended on the 7th and VE Day was 8th May 1945), the American Government rescinded the Lend Lease Act, and it is well known that, because of this and the fact that Britain was hugely in debt, the regime of rationing was even harsher within Britain after the War ended than it had been during the worst of the War. These factors drove the foundation of the post-war Labour Government's export campaign – if Britain did not export, it could not afford to import the food needed to feed its people. The Government's slogan at the time was: "Export or Die". We might consider this a little melodramatic now, but in the immediate post-war era, this slogan was employed by the Government to exhort all British manufacturers to bring in foreign revenue - sometimes to the detriment of domestic production - in support of economic growth. With the urgent need for the country to earn foreign income to aid reconstruction, priority was given to supplying raw materials to those companies which concentrated on exporting their products – hence, the maxim "Export or Die" had very real meaning. Ferguson and Black were assertive – they persuaded Sir Stafford

Cripps, President of the Board of Trade, to sanction a loan and materials for commencement of tractor production, and Cripps advised Black to build the tractor!

As usual, Ferguson was to be in charge of design, development, sales and service, while the Standard Motor Company made the tractors for him. The two men thought on similar lines and realised that a commonality of some components between tractor and car (in reality, there were very few), combined with economies from greater volumes and some sharing of overheads, could reduce costs for both enterprises. To simplify production and cut costs, Black had decided on a single model policy for new cars, and planning for what became the Standard Vanguard commenced in 1945. In the interim, the Canley factory re-commenced production of what were basically pre-War models with some modifications: Standard 8 and 12 models in July 1945, and the 14 in June 1946.

Development

The Ferguson Tractor was announced to the press in November 1945 and tractors were produced in July 1946, although agreements, giving the Standard Motor Company the right to manufacture the Ferguson tractor for 10 years, were not finalised until August 1946 – Harry Ferguson believed that a handshake between gentlemen was sufficient! It was an expensive time for Standard as the company had bought the rights to Triumph for £75k (although this was recouped immediately from the sale of the bombed-out factory – I am indebted to Graham Robson for this “inside” information, which corrects data from another source!) and then spent a further £3 million over the next two years on re-tooling Banner Lane for Ferguson production and in adapting Canley for the Vanguard. Harry Ferguson set up an independent company (Harry Ferguson Ltd - HFL) to market, design, research and develop the tractor and its implements. This company joined the American Harry Ferguson Inc. under Ferguson Holdings Ltd. HFL operated from premises leased from Standard at Fletchamstead Highway, adjoining the Canley site. Harry Ferguson moved back to Britain from the US, buying Abbotswood, a 600-acre estate near Stow-on-the-Wold. Work on tractor and implements commenced in 1945, based loosely on the American Ferguson-Ford design – but much was changed. Incredible as it may seem, everything was drawn twice – by Ferguson’s draughtsmen, then to suit Standard’s own filing system! A limiting factor was the size of the tractor’s rear axle, which provided the mountings for the Ferguson System’s unique and patented 3-point linkage - the configuration couldn’t be changed else the older Ferguson equipment wouldn’t fit. The axle was based on that of the American Ford Ferguson light truck, which restricted power to 20 hp!

The first product of the new "alliance" was the TE20 (TE = Tractor England), and the first one came off the Banner Lane production line on the 6th July 1946, equipped with an engine from Continental Motors Corporation in Michigan, USA. The little grey Fergie, as it became known, was a milestone, not only for Ferguson, but for agriculture in general, as it was so light and manoeuvrable, could be equipped with a wide range of equipment and tools built to the same System - and it was affordable and inexpensive to run.

Under Ted Grinham, design and development of the British engine proceeded at Standard, and, whilst the design was loosely based on Continental’s engine, there were no licensing issues. There was influence also from Citroën’s 1911cc, wet-linered, overhead-valve engine, used in the 1939 Light 15 car. The Standard engine was 1849cc, 80 x 92, using flanged wet-liners with figure of 8 sealing gaskets at the bottom, and the oil filter was external (unlike the Continental, where the filter was inside the sump, making replacement - via a cover plate at the base of the sump -

a messy job, with the risk of subsequent oil seepage from the cover). A Zenith carburettor was chosen – although not liked by Harry Ferguson, he couldn't afford the £25k cost of developing something else! The design target was 25 hp at 2,000 rpm (governed speed), with an operating range of 400-2,000 rpm.

The Tractor/Vanguard Engine

In designing a dual-purpose, tractor and car, engine, Ted Grinham and his team had to cater for the major difference in the construction of the vehicle: in the car, the engine/gearbox assembly is supported on a chassis, but in the Ferguson, the engine is the **sole** structural member linking the front axle to the rear of the tractor – in this role, it is subjected to considerable bending forces (note: this technique has been used in rear-engined Formula 1 cars for several decades now). On a Continental-engined Ferguson there are ¾ inch diameter tie bars down either side of the bottom of the pressed-steel sump – these being required to provide the structural strength necessary between front and rear. With Standard's tractor engine, the block/crankcase and sump were designed *ab initio* to support the whole structure without any such reinforcement, which required these castings to be far more massive than those for the Vanguard car, although within the engine, there are numerous similarities.

At the front of the tractor engine (see Figure 1), there is a substantial front axle support assembly, which encloses the crankshaft-mounted (fan belt) pulley wheel on both sides and below, and is bolted to the block and to the sump. This assembly provides the central pivot for the front axle, in addition to the mounting points for the radiator and the bonnet, which hinges forward (like the later Triumph Herald) to expose the engine. The forward end of the fuel tank is supported by a bracket which is part of the thermostat housing casting.

Production

Initially, the Ferguson TE20 Tractor was fitted with the imported Continental 1966cc Z-120 unit. However, once the 2088cc unit being developed for the Standard Vanguard became available in September 1947, the tractor version of this engine, at 1849cc capacity, was phased into Ferguson production from 26th January 1948, although tractors with Continental engines remained in production until July 1948. There were two engine production lines at Canley, one for car engines, the other for tractor engines; the latter then were transported to the Ferguson works at Fletchamstead. The Standard tractor engine was designated TEA20 (there is debate as to whether or not there should be a hyphen or stop in this designation, so I have made life simple!), with pre-production from September 1947 and the first public demonstration of a Standard-Ferguson on 11th December 1947. Arnold Staples tells me that in all performance demonstrations of Ferguson versus other tractors - however powerful - the opposition was thrashed on pulling power, ease of use (so little time required to hitch and dismount equipment), manoeuvrability and economy.

Modifications to Standard's tractor engine in 1948 included: different steel for exhaust valves and a change to Tecalemit inclined oil filter (replacing vertical type). The tractor engine was initially 80 x 92 = 1849cc, with a compression ratio (CR) of 5.77. Throughout, I have discarded the conventional representation of CR e.g. 5.77:1, as all ratios are with respect to one.

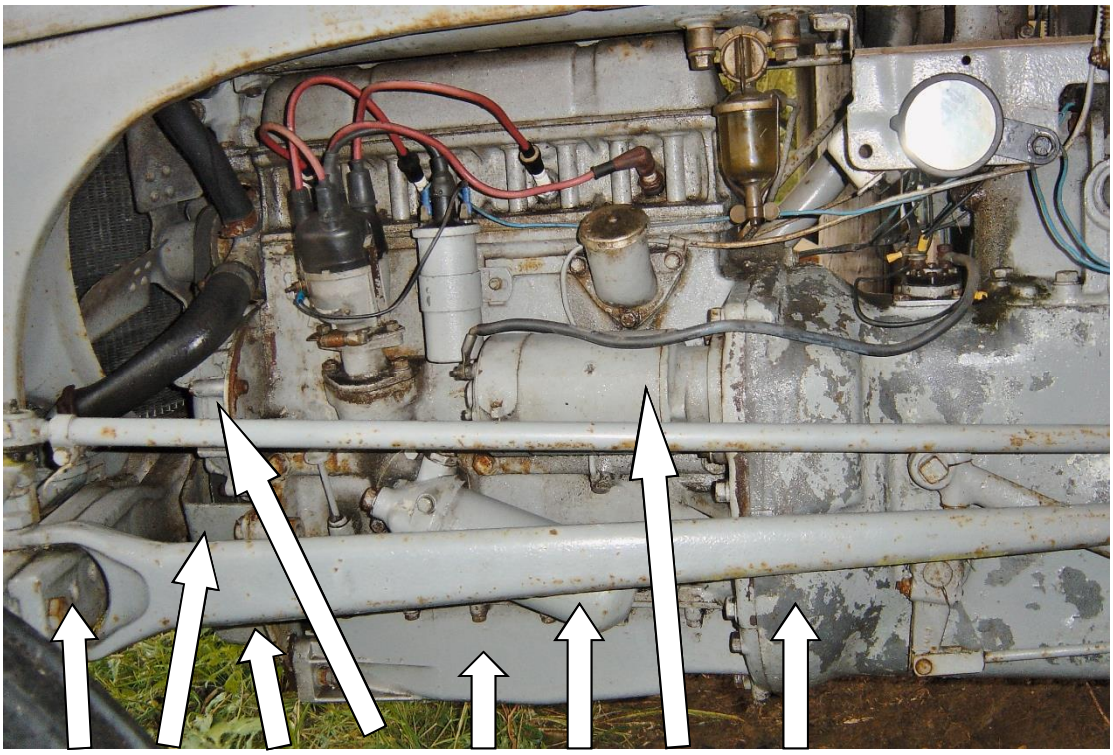


Figure 1 – Standard Engine of Colin Boother's Petrol/TVO Ferguson

1 - Front Axle, 2 - Front Axle Support Assembly, 3 – Alloy Cover over Timing Chain & Governor, 4 – Alloy Sump, 5 - Oil Filter, 6 - Starter Motor, 7 - Clutch Housing

The engine produced 23.9 belt horse power @ 2,000 rpm – an engine speed which was seldom used. Belt horse power is easy to measure on a tractor as there is a take-off pulley used to drive static machinery (this pulley was an option on the Ferguson and was fitted onto the Power Take-Off at the rear). In 1950 (tractor 172598), the engine was increased to the same dimensions as the Vanguard car: 85 x 92 = 2088cc (giving 28.2 belt hp @ 2000). The CR of the petrol engine was increased later to 6.0; for use with TVO fuel (Tractor Vaporising Oil), the CR was 4.8 (23.9 belt hp), later 5.1 (25.0 belt hp). The lower-revving tractor had semi-circular inlet and exhaust ports, and equal-sized valves with single springs, whereas the car had its exhaust smaller than the inlet and two springs per valve. The tractor's sump and timing cover, both of which were structural members, were made of cast alloy – instead of pressed steel for the car, where they are just covers.

Despite the fears about the strength of the tractor's rear axle, Arnold tells me that he met only two cases of rear axle failure.

In both instances, this was as a result of ploughing with (at the rear) one steel wheel (i.e. no tyre) and the other a rubber-tyred wheel. In fact, the weakness of the Ford-Ferguson axle lay in the pinions within the differential, not in the crown wheel and pinion, and the factory made available a modification to beef-up the differential.

Although only 314 of the Ferguson TE20 Tractors were built in the first year of production (1946 – all with the Continental engine), 20580 were produced in 1947 and, by the time the last one was produced in 1956, a total of 517,651 (including variants) had been built. These sales figures are an indication of its unique capabilities - Ferguson's patents on draught control, combined with the huge range of implements, meant that no other manufacturer could compete. Alongside the competition, the Fergie looked almost fragile (which it wasn't) and lightweight (which it was, its dry weight being just a shade less than the Phase I Vanguard), but its performance far exceeded that of heavier and more powerful beasts – it punched well above its weight! The Fergie was immensely popular and had captured almost 80% of the tractor market in Britain by 1949; even today, many TE series tractors (and their successors up to 1956) are still in use. The replacement for the TE series, the FE35, was fitted with the same Standard engine, but using 87mm liners to increase capacity to 2187cc and thereby give a useful boost to torque and power. Harry Ferguson, having received "an offer he couldn't refuse" (as Michael Thorne, described it!), teamed with Massey-Harris to build rather more powerful tractors, but still based on the Ferguson System, and Standard manufactured tractors for Massey-Ferguson until about 1958.

The Standard Vanguard

During the War, a huge number of Americans were based in Britain and a fair number of American cars must have been brought over for the senior personnel and for staff use, and these cars were left here – after all, an American would not want an old car when he got back home! The Vanguard was a completely new design, its exterior styling being reminiscent of many contemporary American saloons, especially the Plymouth. The bold four-door body featured a distinctive, sloping rear boot lid and an attractive "wrap-around" grille – quite unlike any other British car. Although the Vanguard still had a separate chassis, the mechanical specification was thoroughly modern and included all-synchromesh gears (with column change, but only 3 forward speeds), coil independent suspension at the front, and 4-wheel hydraulic brakes when many contemporary cars were still using mechanical linkage for the rear. Beneath the bonnet sat the all-new four cylinder, 85 x 92 engine of 2088cc, complete with down-draught Solex carburettor, overhead valves and a CR of 7.0, producing about 68 BHP @ 4,200 rpm. The Vanguard was announced in July 1947, but produced from April 1948 (according to the Standard Motor Club - another source gives July) – although only about 1,750 cars had been produced by October 1948, and most were for export. The car was an instant success, selling well at home and abroad in all the important export markets, and it gained a considerable reputation for being tough and capable of withstanding considerable neglect and abuse. In 1948, production of the Standard 8, 12 and 14 models ceased (with a total of just over 90,000 cars), and that September, Standard announced estate, van and pickup versions of the Vanguard. Great numbers of Vanguards were sold into all branches of the armed services, both in Britain and abroad. Production of the initial Phase I Vanguard ceased at the end of 1952 (or January 1953) after 184,799 units had been sold, and it was succeeded by the Phase II, in which the only significant change was to the shape of the rear of the bodywork.

Standard stuck with the single model policy until September 1953, when the new Standard 8 commenced production. It is worth mentioning that the basic design of this little, 803cc, 4-cylinder, engine grew and grew in bore, stroke and number of cylinders to power the Vanguard 6, Herald, Spitfire, Atlas van, Triumph 2000, Vitesse and, ultimately, the (2498cc) TR5/250/6 and the saloon 2.5PI/2500 – but that's another story!

Which came first - the chicken or the egg?

The Ferguson tractor, using a Continental engine, was first sold in July 1946, while the first Ferguson with a Standard engine dates from 26th January 1948. The Standard Vanguard was announced in July 1947, but production was awaiting completion of the new engine line at Canley. For the Vanguard, production commenced in April 1948, with the engine being 2088cc, 85 x 92, from the start.

It seems to me that although Fergusons with the Standard engine were available a few months earlier than the Standard Vanguard, it was really the case that engine design, development and production were combined, and that it was basically only a matter of allowing the engine a higher rev limit which changed it from a unit ideally suited to a light tractor to one ideally suited to a saloon car. The most significant differences were:

- Crankcase/cylinder block casting – far more massive for the tractor
- Cast covers for sump and timing chain (pressed steel for the car)
- Cylinder head casting – the tractor had semi-circular inlet and exhaust ports
- Valve sizing
- Cylinder bore (initially - although the tractor was increased from 1849cc to the same 2088cc in mid-1949)
- Position of the starter motor – left for Ferguson, right for Vanguard
- Inclusion of a centrifugal speed governor on the tractor's camshaft drive
- Oil filler on the side of the cylinder block on the tractor, whereas through the rocker cover on the car
- Gravity-fed Zenith up-draught carburettor on the tractor, pressure-fed Solex down-draught on the car, which had vacuum advance on the ignition
- 6 volt electrics on the tractor up to 1951, 12 volt on the car from the start.

My father had his butcher's shop on the steep Lansdown Road in Bath, and I can remember a friend's father driving us - three schoolboys - in his new Vanguard up that hill at a speed which seemed phenomenal at the time! And it was, because most rival family cars were using engines of about 1500cc. Ian Gibson recalls that his father ordered a new Vanguard Phase 1 and, having run it for a year, he found them so much in demand that he sold it for the price he had paid - plus a second-hand Standard 8 drop-head thrown in! Note: this was NOT the new Standard 8, which was produced from 1953 onwards.

From Vanguard to TR

In order to minimise the costs involved in developing the Triumph sports car, as much as possible had to be based on existing components from the Standard cars of the time: the Vanguard and the Mayflower. The former was chosen for engine and gearbox, the latter for front suspension and rear axle. What a pity that the Mayflower's rear axle was chosen, as it was quite inadequate for the task! I have never understood how the racing and rally teams managed to cope with oil-soaked rear brakes, nor why the factory took so long to resolve the problem by changing to the "Girling" axle!

Whenever an engine, even one which is considered strong, highly reliable and capable of lengthy service, is used as the basis for a "souped-up" version, there is a good chance that the extra stress resulting from such changes as

higher rotational speed and higher compression will reveal problems never previously seen. This was the case when Triumph took the Vanguard engine as the basis for its new sports car. Let's look at the vital statistics:

Vehicle	Bore/Stroke	Capacity	CR	Power @ rpm	Torque
Ferguson	80 x 92	1849cc	5.77	23.9 Belt HP @ 2,000	
Ferguson	85 x 92	2088cc	6.0	28.2 Belt HP @ 2,000	
Vanguard	85 x 92	2088cc	7.0	65 BHP @ 4,200	113 lbf.ft @ 2,000
20TS	83 x 92	1991cc	7.5	75 BHP @ 4,500	
TR2	83 x 92	1991cc	8.5	90 BHP @ 4,800	117 lbf.ft @ 3,000

Notes The Ferguson figures are for the Standard TEA20 engine; the tractor's power was always measured at the belt.

20TS is the car which was shown at the Earls Court Show in 1952, but never actually produced (for which we should all be extremely grateful!).

The Vanguard produced about 68 BHP (bare); torque was 108 lbf.ft @ 2,000 initially, then increased to 113 lbf.ft @ 2,000 (Ian Gibson cannot say why!).

The TR2 was announced in 1952, but sold from 1953.

Problems and Solutions

In two articles in The Autocar in April 1955, John Rabson described the development of the TR2. The first article detailed the considerable number of changes required to the Vanguard engine in order to create a sports car engine which was as thoroughly reliable and tough as that of the Vanguard.

1. **Head Gasket**: to cope with the higher compression ratio, a considerably greater torque (increased from 60-65 lbf.ft to 100-105 lbf.ft) had to be applied to the head nuts. This caused the upper surface of the block to lift around the studs and, as a consequence, the head gaskets blew. Solution (see Figure 2): the block casting was modified so that the studs screwed into the base of the block (i.e. the upper part of the crankcase chamber), thereby putting the water jacket into compression rather than tension. In addition, the extra torque on the head nuts squashed the figure of 8 seals at the base of the liners to such an extent that the small upstand of the liners above the block was lost, which caused the head gasket to blow! A change of the figure of 8 seals, from a soft material to copper, solved the problem. As a further precaution (remember that the liners should sit only a few thousands of an inch above the top of the block), production tolerances on the various components were reduced.

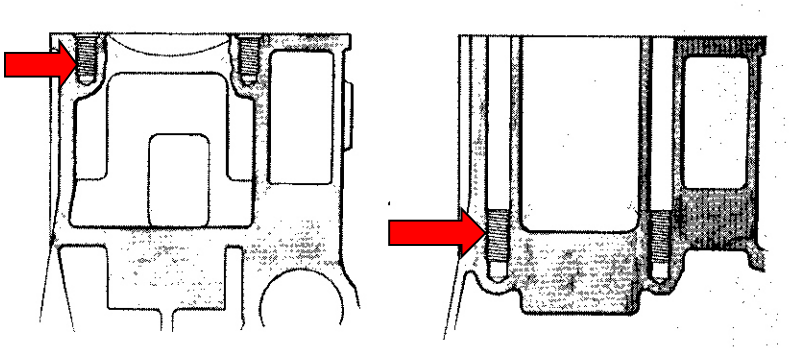


Figure 2 – Location of Head Stud Bosses:

Vanguard (left) and TR (right)

2. **Big-Ends**: the combination of higher engine speeds (up to 6,000 rpm), greater compression and better breathing in the TR mean that the loading on the big-ends will be much higher than in the Vanguard. Big-end failures occurred after 2-3 hours at sustained 5,200 rpm, so the bearing material was changed from white metal to indium-coated lead bronze bearings. Then, modifications were made to the main bearing shells so as to permit oil to pass more rapidly from the crankcase via the main bearings to the crankshaft, and thence through the crankshaft drillings to the big-ends. This was not a complete cure – see next!
3. **Crankshaft**: see Figure H2, which Neil Revington drew for me in 1976 for the Technicalities Booklet, and which was reproduced in Section A8 of the Technicalities CD. The crankshaft was originally drilled from the main bearings to the big-ends (see upper drawing), but, with the higher crankshaft speeds and the increased bearing clearances necessitated by the use of lead bronze bearings, this resulted in a considerable loss of oil owing to centrifugal action. To reduce this effect, the crankshaft drillings were modified (see lower drawing) so that the greater proportion of the oil would be discharged around the periphery of the big-end bearing, which is closer to the centre line of the crankshaft, by making a **¼** inch cross-drilling, and by reducing the diameter of the outlet at the outer end of the main oilway to $^{5}/_{64}$ inch. In addition, to improve the spread of oil round the bearing, the edges of the outlets were "shelled", and this process also prevented foreign matter "cutting-up" the bearing shell.
4. **Connecting Rods**: no failures occurred, but stiffness was increased and the location between the rod and the cap (see Figure 3) was improved by use of a single tubular dowel to prevent shear loading on the bolt itself, and the big-end bolts were increased to $^{7}/_{16}$ inch.

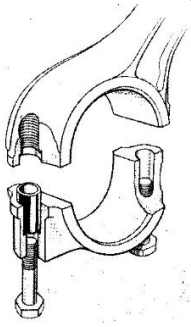
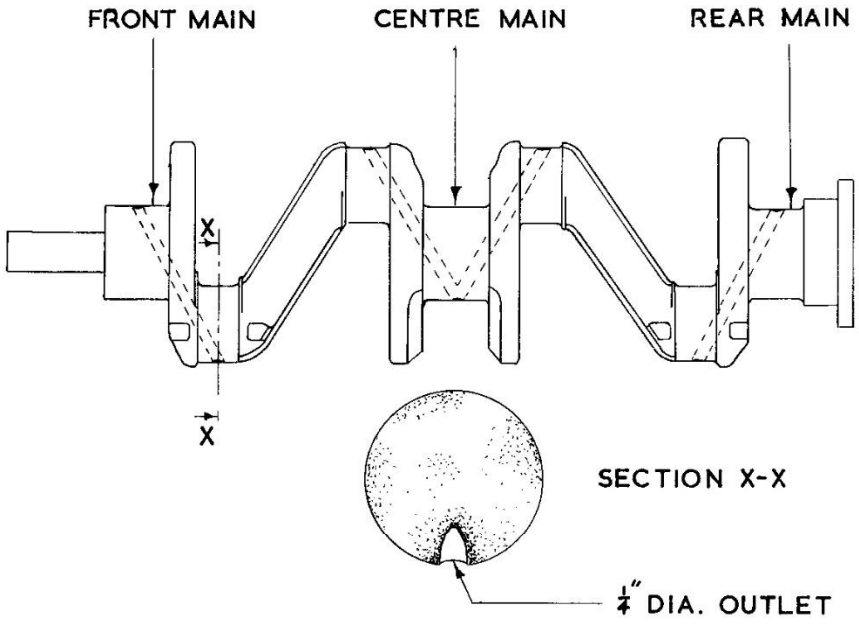
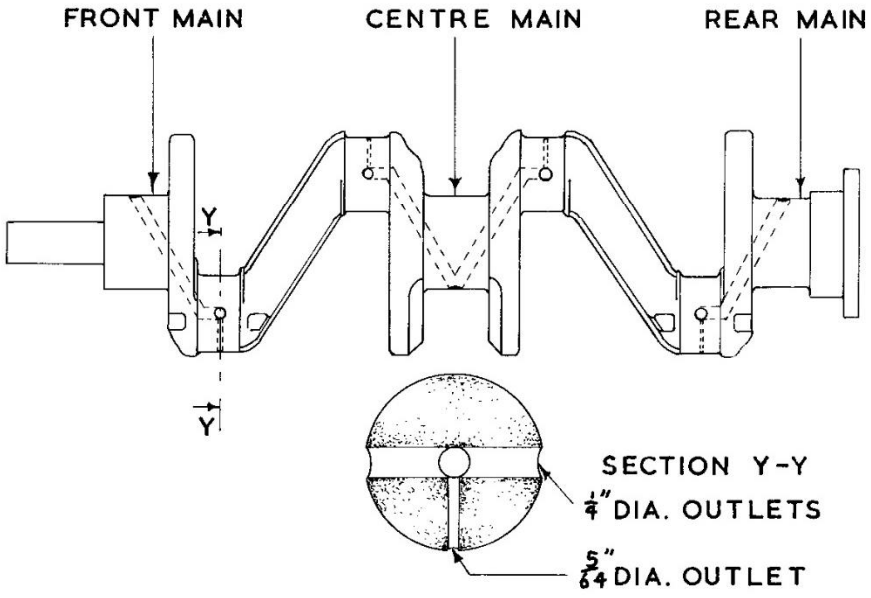


Figure 3 – Connecting Rod: Dowel locating the Big End Cap



EARLY CRANKSHAFT. (PART No 58142)



CROSS-DRILLED CRANKSHAFT. (58142 STAMPED WITH PART No 301815)

FIG. H 2 BIG END LUBRICATION

5. **Valve Gear**: number 1 exhaust failed after 246 miles at over 5,000 rpm – this was not repeated on the other valves. Special stroboscopic and electronic test equipment showed that the camshaft was bending at about 6,000 rpm – much more on number 1 (0.019") than number 3 exhaust (0.008"). Increasing the shaft diameter by $^{1}/_{8}$ inch along its length didn't solve problem. The solution was to increase the diameter of the front half of the camshaft only. As a precaution, the valves were strengthened.
6. **Oil Sealing**: at the rear main bearing, in addition to the outer return oil scroll, a scroll was added to the crankshaft itself.
7. **Crankcase Breather**: there was a loss of oil from the breather pipe when cornering fast (Vanguards are not usually subjected to this sort of treatment!), so the shape was modified to avoid oil being flung out and to condense oil vapour and thereby permit the condensate to flow back to the sump.
8. **Cooling Fan**: the bonnet and radiator on the TR were so low that the fan couldn't be belt driven, but had to be mounted on the front end of the crankshaft. Torsional vibration of the crank caused breakage of the fan until rubber bushes were inserted in the fan's mounting.
9. **Oil Filter**: initially, a bypass type was used, but, at engine 12650E, this was changed to full-flow in order to increase reliability and longevity.

Conclusion

I can look back to that immediate post-War era of austerity and remember the rationing, the derelict buildings, the canvas visible on vehicle tyres, the pipes freezing and bursting in the winter, the ice on the inside of the bedroom window in the morning, the chilblains on my ears, the multi-coloured bedsocks knitted by my mother, and the frequent power cuts – candles and matches at the ready in every room! So, it is amazing to consider that, more than 60 years on, we are driving TRs which, using that same basic engine design and construction, are producing some five (and more) times the tractor's power output - and with great reliability. In fact, the rally/racing folks are getting about eight times the power with good reliability. Of course, these TR engines have:

- greater capacity (around the 2.25-2.5 litre mark)
- higher compression (CR of 10 and more)
- better breathing (inlet & exhaust manifolds, valves and carburettors)
- better camshafts, pistons, connecting rods and crankshafts
- and they spin at much higher speeds (three and more times as fast as the tractor's engine).

In summary, I believe we owe Ted Grinham and his team a great deal for giving us an engine which really has stood the test of time in all three of its forms!

Acknowledgements

I have used a number of invaluable web, published and oral sources in compiling this story, and I am greatly indebted to each of them. They are:

a) Ferguson TE20: website ***ferguson-museum.co.uk/52_ferguson.html***.
b) Standard Vanguard: websites ***standardmotorclub.org.uk*** and ***autoclassic.com/features/classic_car_history/standard_vanguard.html***.
c) "The Ferguson Tractor Story" by Stuart Gibbard, ISBN 1903366089.

d) Gary Anderson of the Ferguson Club, for directing me to members of that club who had great knowledge. Incidentally, Gary has owned a TR7 since 1980 and has been a member of the TR Register for more than 25 years – small world!

e) Michael Thorne, for giving me an engrossing guided tour of The Coldridge Collection, his Ferguson museum in Devon, and for his book, "Ferguson TE20 in Detail", ISBN 0-9549981-3-8. For details of his museum, see website ***fergusonclub.com/gallery/Album/Coldridge%20Collection/Album.html***.

f) Arnold Staples, for information about Fergusons, resulting from his many years of experience at Hoggarths, the Preston agency for the tractors. Bob Dickins and John Ainsworth, Ferguson enthusiasts living in Winslow, who demonstrated their tractors and implements, answered my questions, allowed me to photograph important details and to drive a Fergie!

g) Mike Ellis (TR Register's TR2/3 Registrar) for useful background material – he learnt to drive on a Fergie! Colin Boother, TR Register member, for photographs of his own Fergie. Ian Gibson (TR Register's Technical Editor), for an amazing amount of information on Fergusons (both Continental and Standard-engined), Vanguards and TRs – is there no limit to this man's knowledge and experience!

h) "A Triumph of Development – the story of the TR2" by John Rabson, printed in The Autocar on 8th and 22nd April 1955. It should be noted that there were some factual errors in these articles, and those concerning the engine have been corrected herein. From these two articles, Dave Allen & Dick Strome obtained the text for the first part of Chapter 6 of their "Triumph Guide", published in 1959 by Sports Car Press, 419 Fourth Avenue, New York 16, NY (Library of Congress Catalogue Card Number 59-9853) – so it contains the same errors!

i) Graham Robson (renowned author and the TR Register's Honorary President) for a great deal of help and encouragement, and for correcting various of my errors concerning Standard's history.

j) Neil Revington, for information on the TR's crankshaft oilway drillings and his splendid illustration.

Development of the 4-pot Engine

Letter from Phil Homer, Standard Motor Club

I read with interest Ian Cornish's excellent article that includes development and production of the Ferguson Tractor. Ian queries why Standard considered it necessary to redraw all Ferguson's drawings.

There certainly was good reason.

Standard's role in the Black-Ferguson partnership was to manufacture the Tractor to designs supplied by the Ferguson company. First, Ferguson's delays in providing the drawings and associated specifications caused considerable delays in Standard's re-equipment programme to build the machines at Banner Lane. Indeed, contemporary documentation complains that no material specifications were ever received, so Standard had to develop their own. In the case of the drawings, they were regarded as "illegible and incomplete" so it was decided that they should all be re-drawn in Standard's own engineering practice. Indeed, the companies agreed that they would never be able to use each other's drawings

It seems that during that redrafting process it was discovered that several major components, to use the modern terminology, were "not fit for purpose". Indeed Ferguson delivered a fully built up prototype which was deemed inadequate. Standard decided to bite the bullet and to completely redesign several major components, not least

the gearbox and rear axle, hood and cowl, power takeoff, radiator and grille, brake and clutch controls. The view must have been taken that though this was not their role in the "partnership", not to do so would have resulted in further unacceptable delays and an unserviceable Tractor would have been the outcome, even if Standard managed to build it at all. Sir John wrote on 16th May 1946 that "without exaggeration, 75% of the engineering that we believed had been completed and proved in the USA has been completed by us, before any production work could proceed". You can understand that the relationship between the two companies and between their MDs was stretched to the limit during that period of the partnership. The cost of the revision work was put at £450,000 (an astronomical sum at the time) and it is recorded that Ferguson admitted that his company was liable for these costs. It was later agreed that sum be amortised over the sale of the first 25,000 tractors.

Sir John was also wary of the situation that had developed following the breakdown of Ferguson's earlier "handshake agreement" with Henry Ford. Ford had used Ferguson drawings, by agreement, to manufacture the Ford-Ferguson tractor before the war. After Henry Ford died, his son "tore up" the agreement and carried on building tractors with modifications intended to overcome Ferguson patents. Ferguson sued and after a long litigation was awarded huge damages.

By redesign of the major components, Standard could rightfully claim that the majority of the design work was their own. Though the two parties never fell out, Standard insured themselves against such a situation arising again by this action. The other, and main, outcome was a highly successful tractor which had rather more "Standard" components in it than Ferguson originally intended. Over half a million Tractors later, isn't it a good job those drawings were changed?

Regards, Phil Homer, Webmaster, www.standardmotorclub.org

From “The Book of the Standard Motor Company”

by Graham Robson

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It is important to emphasise that the tractor version of the engine was really quite radically different from that fitted to cars. In the Ferguson tractor, the engine was the only structural member connecting the front axle to the rear of the machine, by way of an equally massive combined gearbox/rear axle assembly. Accordingly, the only direct dimensional connection between the cylinder block of the tractor, and that of private cars like the Vanguard, and the closely related post-war Triumphs, was that the bore centres and the choice of cylinder bore dimensions were the same (which was, of course, a ‘given’ for mass-production machining purposes), though it now seems that the two similar-but-different engines each had their own dedicated assembly lines at Canley!

There was so much bending stress on engines used in this way that on Continental-engined Ferguson tractors there were additional ¾ inch diameter tie bars running alongside the bottom of that engine’s pressed steel sump to help provide the necessary beam strength. Standard’s engine designers knew this, and made sure that their cylinder blocks were (and always were) far more massive than those specified for Vanguard private cars.

The original Standard engines fitted to Ferguson tractors from January 1948 measured 1850cc (80 x 92mm bore and stroke) and produced 25bhp at a regulated 2000rpm: an increase to 2088cc (a well-known 'Vanguard' dimension) followed in 1949, and was further increased to 2188cc (with an 87mm cylinder bore) for a bigger and heavier Ferguson tractor in 1956.

Another major problem was that Standard soon discovered that the level of the technical details handed over to it by Ferguson was by no means good enough, or comp1ete enough, for major tooling, and manufacturing, to start. Although it has often been pointed out that Ferguson handed over engineering drawings, and that Standard then had to redraw all of them 'for its own purposes', it has not always been clear as to why. In fact, Standard had to develop many of its own material specifications (which were not provided), and that major items such as the gearbox, back axle and power take-off had to be completely redesigned by Standard; all the evidence is that Ferguson never thanked Standard for this, though undoubtedly it saved the project from disaster.

As Alick Dick later told the author: "When the drawings arrived at Banner Lane for us to make the tractor, there was no drawing of any engine, there was no gearbox and there was no differential. Henry Ford, course, had made all these, in America, and they were part of the Ford truck programme. We had no drawings or process sheets so we didn't have any idea of what materials that tractor was made of. So we had to start, and engineer the tractor from scratch".

To quote from one of Sir John Black's coruscating notes preserved in the company archives: "without exaggeration, 75 per cent of the engineering that we believed had been completed and proved in the USA has been completed by us..."

He then put the cost of revision/completion at £450,000 (which, at 1946 currency values, was a vast sum of money, but which presumably had been 'talked-up' in Sir John's usual ruthless business manner), and managed to get Ferguson to fit the bill over a period of time. This extra work, of course, significantly delayed work on the brand-new Vanguard, for Standard did not have enough engineers, nor a big enough management team, to work on both projects at once.