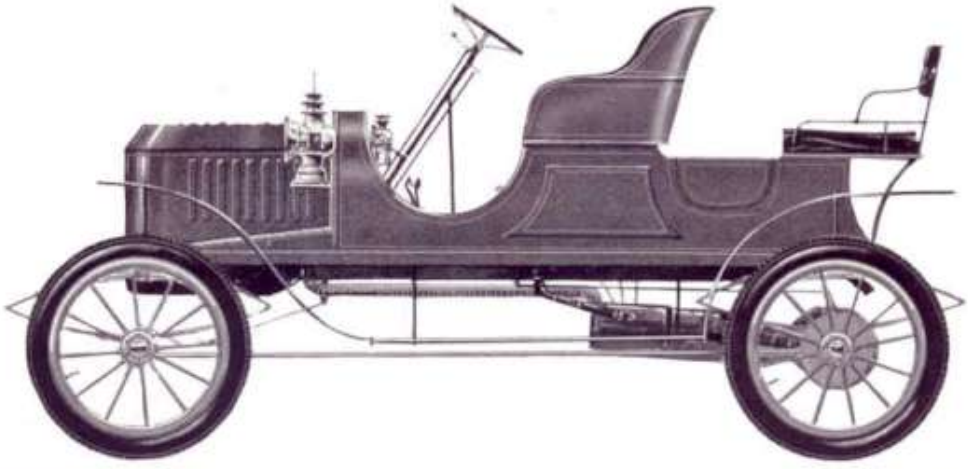
The Stanley Steam Cars, 1897-1907



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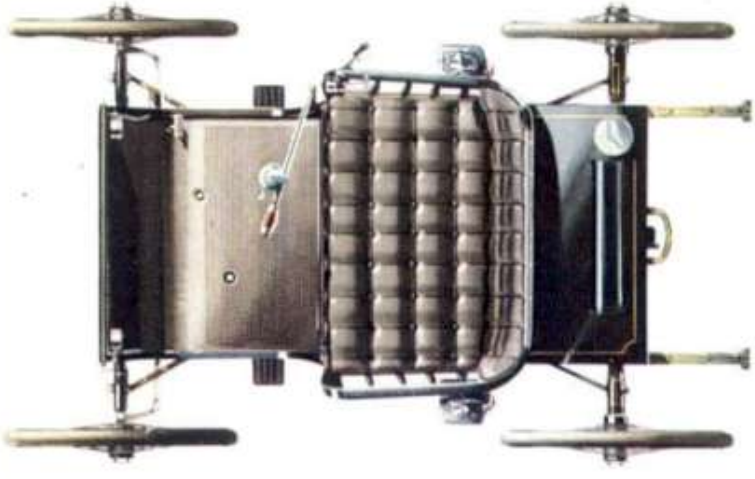


The 1900/01 **STANLEY/LOCOMOBILE STEAM CAR** in The Shuttleworth Collection, Old Warden Aerodrome, Biggleswade, Bedfordshire, England.

The Stanley Steam Cars, 1897-1907

by Anthony Bird

When the motor business started in earnest (and for all practical purposes one may take 1890 as the time and Paris as the place—despite the Teutonic background of the Benz car and the Daimler engine), it would have taken a rash man to pronounce with certainty that the new-fangled explosion engine would win the day.

There were no fewer than 102 entrants for the *Concours des Voitures sans Chevaux* (i.e. the Paris—Rouen Trial) of 1894 and at first sight it seems as though almost as many different systems of propulsion were favoured by the competitors. Compressed air, clockwork and the expansion of carbonic acid gas were amongst the least eccentric of these proposals which ranged from cars to be driven by 'Weight of Passengers' or 'Gas and Pendulum', through the '*Liquides Combinés*' favoured by Desoignes de Malapert et Barriere, to the 'Combination of Animate and Mechanical Motor' to which Messrs. Garnier et Delannoy pinned their faith. None of these strange and terrible devices materialised, and of the twenty-one vehicles which started on the run to Rouen thirteen were propelled by internal combustion engines and eight by steam.

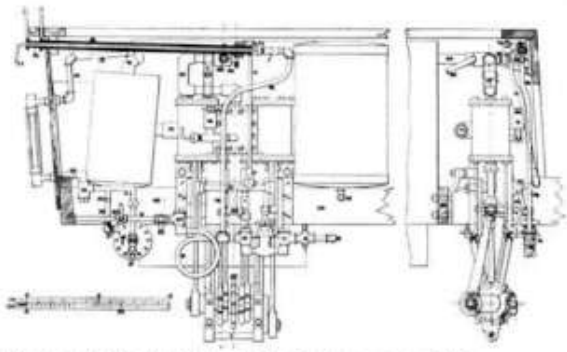
STEAMER MERITS

Despite the success of the battery-electric car as a short-range town carriage and an even shorter range record breaker, steam and petrol cars appeared to have roughly equal chances of carrying the day commercially. Indeed, on paper the steamer appeared to hold most of the aces. With its ability to develop maximum torque at minimum speed the steam engine could propel a car without the complicated, awkward and noisy change-speed gearing the petrol engine demanded. Those two most potent sources of trouble, the carburettor and ignition system were absent. Because of its low-speed torque a steam engine could be geared to do its work at a speed below that at which vibration became a problem, it was quiet and, above all, for every engineer who understood the petrol engine there were a hundred or more who were acquainted with steam machinery.

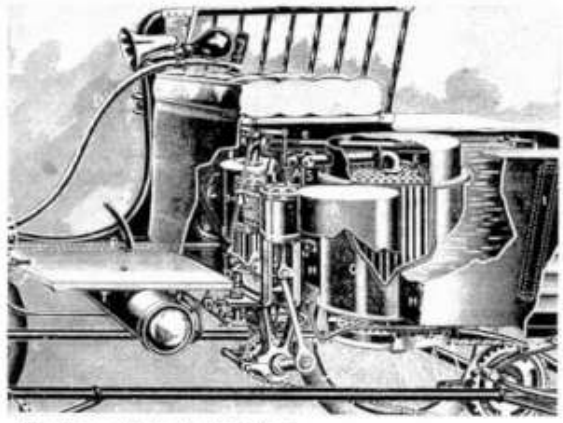
With all these virtues to commend it, the relatively small commercial success of the steam car appears to lend colour to the theory that steam was killed by unfair discrimination by insurance companies, garage and ferry operators, petrol car makers and the different bodies responsible for framing the regulations for sporting contests: this discrimination, it is said, was practised at the behest of the oil companies.

As the steam cars sold to the public all burnt liquid fuel—petrol, paraffin or vapourising oil— there is no truth at all in the suggestion that the oil companies opposed them. As for the 'unfair' regulations to exclude or penalise steamers in hill-climbs and similar events this boils down (the simile seems appropriate) to nothing more than tacit recognition of the undeniable superiority of steam over internal combustion for short distances. It must be said, however, that the controversy on this score was conducted with all that malice, uncharitableness and venom inseparable from the world of sport, which has taken over from

'Wicker-willow lunch basket on wheels': an 1899 example of the Stanley-designed Locomobile.
(Photo: Automobile Manufacturers' Association, Detroit)



Front and side elevations of the Stanley engine, 1899.



Machinery of the 'lunch basket'.

religion as the prime source of strife and intolerance.

STEAMER SHORTCOMINGS

The real reason for steam's ultimate failure was threefold. Despite the apparent simplicity of control the steamer called for more vigilance and mechanical sensitivity in the driving than a petrol car. The lack of complication in the engine itself was offset by considerable complication in the furnace and boiler departments, and the best of steamers required considerably more maintenance work to keep them in good order than the worst of petrol cars: this put them out of court for the majority of owner-drivers, who were often beguiled by the sweetness and silence into buying a steamer and then learnt of the foibles the hard way. Finally, even with a condenser, water consumption was no small problem, particularly as hard water gave rise to a lot of trouble. But it was the complexity which really beat them: 'It's like a plumber's nightmare,' said one engineer called in to cosset an ailing steam car, and it is noteworthy that the most successful make, commercially speaking, was the Stanley and it is scarcely coincidental that it was also the simplest.

F. E. Stanley designed and built his first steam runabout in 1897 (he was not joined in partnership by his twin brother, F. O. Stanley, until January 1899),

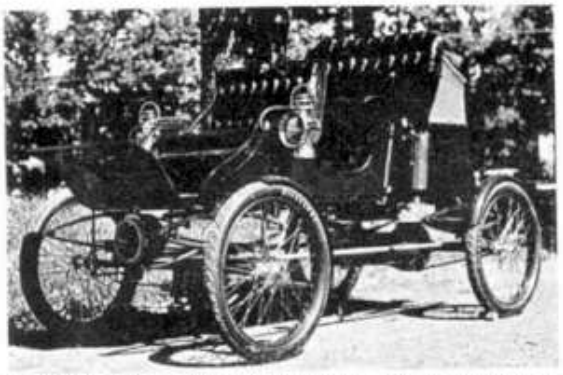
1901 Locomobile, with side-lever steering in place of the more usual bath-chair type of tiller. (Photo: *Autocar*)

using an engine made for him by the Mason Regulator Co. of Milton, Mass. By May of 1899 only three more cars had been made but orders for 200 had been received, so successfully had the brothers demonstrated the cars' merits. To avoid the delays and difficulties attendant upon raising capital and starting a manufacturing venture the twins sold their patents and manufacturing rights to the Locomobile Company, receiving, it is said, $250,000. It was consequently under the name of Locomobile that the Stanley Steam Car first became famous.

THE STANLEY/LOCOMOBILE DESCRIBED

The basis of the Stanley/Locomobile was an unsprung underframe consisting of a couple of tubular axles united by a pair of tubular reach-bars and mounted upon cycle-type wheels: this was a style of construction which several American carriage builders had borrowed from the cycle industry, and it formed the basis not only for a number of horse-drawn buggies and Surreys but for most of the early horseless carriages. The wooden bodywork was mounted on full-elliptic springs (transverse in front and longitudinal behind) and the engine, boiler, fuel and water tanks, etc., were all mounted on the body framing. The whole affair was wonderfully light: the standard two-seater runabout weighed just under 7 cwt complete with fuel and water, and the slightly longer four-seater Surrey or Stanhope type was only about a hundredweight more. The margin of safety was, admittedly, cut rather fine, and the little cars were too frail to give trouble-free service except as town runabouts. This was not illogical: America then possessed few paved roads outside city limits and the Stanley brothers gave tacit recognition to this by designing their car accordingly. As, however, they gave such impressive demonstrations of its ability to cope with steep gradients, and soft roads, many unskilled buyers ran into difficulty by using their cars too ambitiously.

In their quest for simplicity the brothers would have nothing to do with the Serpollet type of flash boiler or instantaneous generator, and poppet-valve high-speed engine. Nor were they tempted to try to economise fuel by going in for the complication of compounding as Whites, their principal rivals, did. The two-cylinder, 'simple' (i.e. non-compound), double-acting engine was vertically placed under the driving seat, with its overhanging, ball-bearing, cranks, cross-head-guides



Intermediate type: a 1903 Stanley with the new arrangement of enclosed horizontal engine supported on the reach-bars, but still with rear-mounted boiler. The occasional seat in front could be folded away when not in use.
(Photo: Antique Automobile Club of America)

and Stephenson's Link valve-motion quite unprotected from mud and dust. The first cylinder dimensions were $2\frac{1}{2} \times 3\frac{1}{2}$ in., which gave $3\frac{1}{2}$ i.h.p. at the normal pressure of 150 lb. sq. in.: for short periods the boiler could easily work up to over 200 lb. and the output consequently be raised to some 10 b.h.p., which gave excellent acceleration and hill-climbing ability. Reserve capacity was very limited, and the little cars often ran out of steam on hills, particularly if fresh water had to be fed to the boiler whilst climbing. The crankshaft was directly coupled to the differential live axle by chain.

The boiler and furnace were of the utmost simplicity, and were placed behind the engine partially surrounded by a horseshoe-shaped water tank holding fifteen gallons. The vertical fire-tube boiler had 298 tubes, 13 inches long of 0·437 in. bore and 16 s.w.g. wall thickness. These tubes were of copper expanded into steel top and bottom plates which gave some pundits to shake their heads and predict corrosion from electrolytic action. The steel boiler shell was bound with piano wire and lagged with asbestos: the burner was designed to operate on petrol which, though more costly and dangerous than paraffin, certainly avoided many difficulties. Anybody who has had to grapple with a recalcitrant blow-lamp will be acquainted with the wide variety of perverse and ingenious ways in which a vapourising paraffin burner can give trouble. A rather troublesome device called the firing iron, which had to be detached, heated to red-heat and then screwed back into place, was used to pre-heat the vapouriser before turning on fuel. The pilot burner could then be lit, and within a few moments the main fire would light and the whole operation of starting the furnace from cold and getting up steam took about fifteen minutes.

The brothers viewed thermostatic devices with suspicion, and the only automatic control in the original Stanley system was a simple pressure diaphragm valve which closed the main burner supply when pressure reached a predetermined point. The pilot burner remained alight ready to re-kindle the main fire when pressure fell again The pilot was also designed to keep the boiler hot enough to maintain pressure when the car was stationary, but for obvious reasons it was unwise to leave a steam car standing unattended for very long with the pilot burner going.

An obvious disadvantage of the fire tube boiler, by comparison with the flash generator, was that the water level had to be carefully watched. As the boiler was behind the driver this entailed having the gauge-glass mounted on the side of the body work, and the driver was supposed to be able to read it by means of a mirror on the dashboard. Reading a water gauge glass under certain conditions of light is difficult enough, but reading it at some three feet distance in a little looking-glass, on a moving vehicle, was almost impossible. Silt or scale, prevalent in hard water districts, in the gauge could add to the difficulty by giving a false reading.

The 'Gentleman's Speedy Roadster' was as delightful as the name suggests. (Photo: Mr. Kenneth H. Stauffer)

With windscreen and side doors: 1908 example of the EX. (Photo: Montagu Motor Museum)

A 30 h.p. example of the 'Speedy Roadster' which was capable of reaching 75 m.p.h. in a brief spurt. (Photo: *Autocar*)

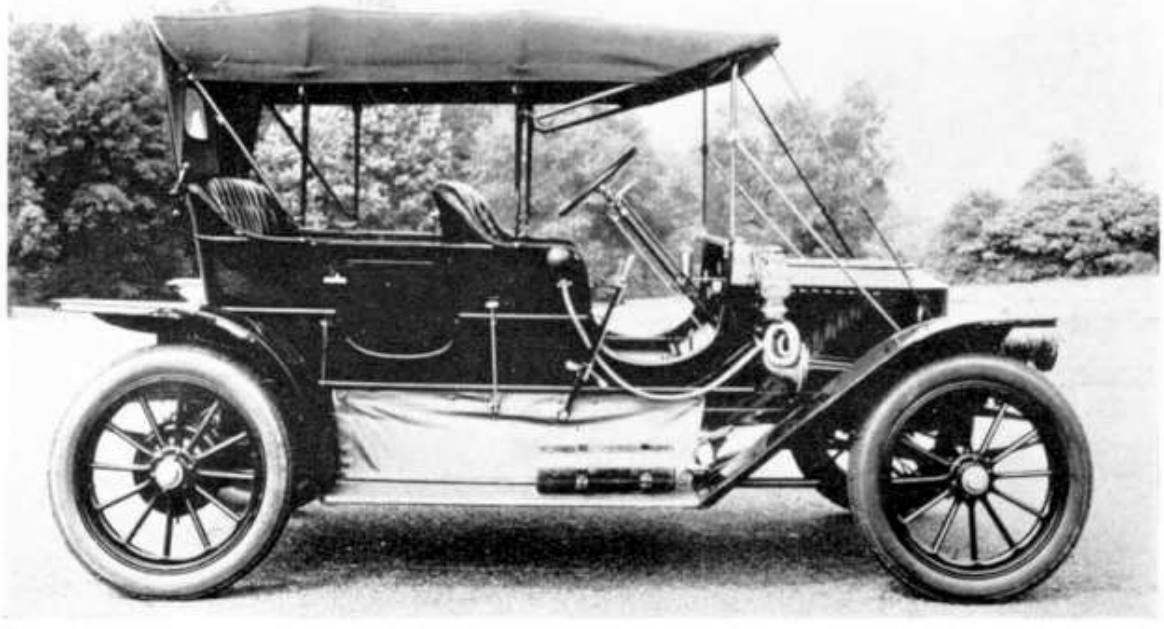
The danger of burning out the boiler was guarded against by a fusible plug which melted as soon as the water level fell and left it uncovered. The remaining water and steam would then escape and extinguish the fire; beyond necessitating the dirty job of dismantling the fire box and putting in a new plug, no harm would be done. In theory that is, for in practice it was often found that if the boiler had got hot enough to melt the plug the bottom plate distorted and set up leaks at the tube joints. Rather more serious damage could be caused by allowing the water level to rise too high, as the boiler would then 'prime', water would be carried into the engine and give rise to damaged bearings or bent piston rods. In extreme cases the cylinder head studs might be torn out. A mechanical feed water pump was operated from the cross-heads, supplemented by a hand pump for use when the vehicle was stationary.

ON THE ROAD

When all was well the little Stanley/Locomobile runabouts probably provided more pleasurable motoring than anything else on the market at the turn of the century—that is, if they were handled properly—and they became very popular, not only in America but in England where an assembly plant was set up in Kensington. They ran very quietly and with that effortless smoothness which no petrol car of the time could rival. They were also quite lively performers. The maximum speed they could sustain was not much more than 20 m.p.h., but boiler pressure so rapidly rose above normal during a halt, that nearly double that pace could be reached for a brief spurt. A clever driver who knew his car would anticipate a climb, husband power and build up a reserve of steam which would waft him almost noiselessly to the summit at a pace which would put most contemporary petrol cars to shame. On longish hills, however, even the most skilled might run out of steam and have to pause for a few moments.

Apart from those already enumerated, the snags were plentiful. Cross winds could make the burner blow back or blow out. At best this would cause loss of power, and at worst the firebox would flood with petrol and a spectacular flare-up might then ensue when the driver tried to relight the fire. This could happen too on downgrades if the pilot burner misbehaved whilst the main burner was shut down. The general public went in terror of boiler explosions,

Apart from a valance to conceal the engine casing the recipe stays the same—1910 Phaeton. (Photo: Mr. T. Clarence Marshall)



A 1909 Stanley taking part in the 1961 Glidden Tour. (Photo: Montagu Motor Museum)

Despite a burnt chassis member, and a few other little troubles which don't afflict internal combustion cars, this 1906 Speedy Roadster came through the Anglo-American Vintage Rally in 1950. (Below) The 1906 Stanley about to tackle Prescott Hill Climb. (Photos: *Motor*)

which really did not present a hazard (in the unlikely event of a tube bursting the escape of steam was too small to be dangerous), but the timorous were understandably nervous of a flare-up or back-fire.

The frailty of the little machine was a reason for the decline in popularity which set in towards the end of 1901. Things could and did leak, work loose, break or jam with disconcerting frequency. Readers of Kipling's story, *Steam Tactics*, will recall Engine Room Artificer Hinchcliffe's complaint that the steam car in the story (Kipling owned one of the four-seater Locomobiles) was as frail as 'a wicker-willow lunch basket on wheels', and he was horrified to find 'the boiler's only seated on four little paper-clips'. The ordinary unskilled customer found that long-distance touring in a Locomobile called for a good deal of roadside tinkering and even the experts were not immune from trouble. In the winter of 1900 Hubert Egerton, the English agent, drove a Locomobile from John O'Groats to Land's End. The 880-mile journey took nearly twelve days during which the engine gave no trouble—but almost everything else did. Firebox and burners had to be dismantled and cleaned several times, the solitary brake wore out, the rear axle bearings collapsed, feed pump stuffing-boxes had to be repacked frequently, and more than five tons of water had to be collected, often from wayside streams in a collapsible canvas bucket, and poured into the little creature's ever-open mouth.

The water consumption was, indeed, the greatest snag and a bare twenty miles was the limit of running on a full tank and boiler. The obvious remedy of

A good light for the boiler gauge-glass was essential for night driving: 1907 Model EX. (Photo: Charles L. Betts, Jr. Collection)

Five-seat tourer: bodywork for Stanley cars was designed and made by the Company.
(Photo: Antique Automobile Club of America)

fitting a condenser and using the water again was not as simple as it looked. For a large stationary or marine steam plant the condenser may be made of ample size, almost regardless of space or weight, and may be cooled by water so as to create a vacuum on the exhaust side of the engine, thus increasing the effective boiler pressure by some 10 lb. per sq. in. The air-cooled condenser for a steam car could not, in practice, be made large enough to create a vacuum, but tended always to create back pressure which resulted in loss of power. Also further complication creeps in as, with the Stanley type of boiler, it was essential to prevent lubricating oil, carried over with the exhaust, from reaching the boiler as only a small quantity of oil in the water would produce violent foaming and priming. The Serpollet and White type of flash boiler suffered much less from this trouble, but during the period under review condensers were only fitted to Stanley/Locomobile steamers as optional extras designed to avoid the 'showing of visible vapour' which was theoretically illegal in many parts of America and in England. The water of condensation was merely allowed to trickle out on to the ground as it was too oily to return to the tank.

By 1903 the Locomobile Company was losing money and had lost faith in the steam car. Since 1899 the Stanley brothers had not been idle but had evolved a much sturdier design; they bought back their own manufacturing rights from Locomobile at a bargain price, and set up in business first at Newton, Mass., and later at Chicago. The Locomobile Company concentrated on the internal combustion cars they had already started to make during their last year of steam car production.

THE MODEL EX.

Early in 1904 the Model EX Stanley Steam car made its appearance and proved so successful that it remained in production for five years. The original Stanley principles were not abandoned, the only fundamental change being that the burner was redesigned to operate on high-grade kerosene.

The reach bar underframe was retained, but the single transverse front spring gave way to a pair of longitudinal full-elliptics. The body framing was greatly strengthened to become, in effect, a wooden chassis on which different types of body could be mounted, and the boiler and furnace were moved to the front of the car housed under a rounded bonnet. This made the task of keeping an eye on the water level very much easier, and the method of starting the burner from cold was also simplified. There was still no condenser (most police authorities had given up bothering about the 'visible vapour'), but a big water tank under the driver's seat gave the car a range of about 40–50 miles. The engine was still a two-cylinder 'simple', but it was now placed horizontally under the floor, totally enclosed, and supported at its crankshaft end by the back axle which it drove by spur gearing.

The cylinder dimensions of the EX Model were 3 in. bore and 4 in. stroke: with steam at the normal 380 lb. per sq. in. from the 18-inch boiler this engine indicated 10 h.p., but like its predecessors, this could be greatly increased. With boiler pressure just below blow-off point the engine output was probably not far short of 30 b.h.p. which gave the car outstanding acceleration for a few seconds.

A 20 h.p. model was also sold with a $3\frac{1}{2} \times 4\frac{1}{2}$ in. engine (later developed into a 30 h.p. of 4×5 in.): this had a boiler containing 450 21 in. tubes which

Louis Ross's 'Teakettle' (left) with which he covered the mile at 94·73 m.p.h. in 1905. (Photo: General Motors Corporation)

could operate continuously at 650 lb. per sq. in. Most of the bigger models carried four to five seater bodywork, but a particularly delightful two-seater 'Gentleman's Speedy Roadster' was available.

The less exciting EX model was also delightful. It was geared so that the engine revolved only 750 times in a mile, and this really did give a fascinatingly 'long stride' and an impression of effortless travelling scarcely to be matched by the most powerful petrol cars of the time. Despite the flexible frame and soft full-elliptic springs the handling was excellent. About 32 m.p.h. was the car's comfortable cruising pace, but it could work up to about 50 m.p.h. for short distances.

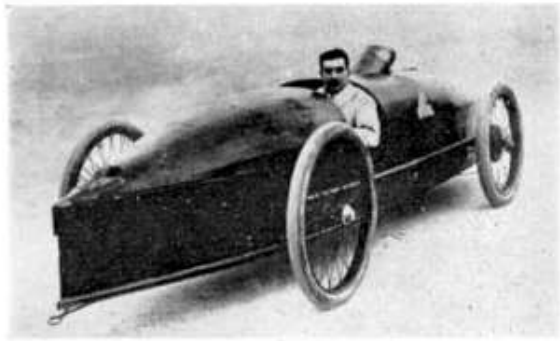
Although many different makes of steam car were launched few of them survived long and none so long as the Stanley, production of which stopped in 1927. Serpollet, with his imitators Miesse and Turner-Miesse, were the principal European exponents of steam, and White was the Stanley brothers' chief American rival until 1912 when the White Co. abandoned steam and concentrated upon petrol cars and trucks. On paper the White was the better car. It had a semi-flash boiler which was more nearly automatic in action than the Stanley's: it used superheated steam and a compound engine which made for efficiency and fuel economy, and a condenser and filters conserved water and gave the White double the range of the Stanley. Also the White had a two-speed gear in the back axle which allowed it to cope with extreme conditions of soft ground and steep gradient which might combine to defeat its rival.

Yet there can be little doubt that the Stanley was much the pleasanter car to drive or ride in, and the designers were justified in their liking for old-fashioned unsophisticated machinery.

STANLEY RECORD-BREAKERS

As we have seen, steam cars were barred from many sporting events in which their particular virtues were thought to give them an unfair advantage; from other types of contest they excluded themselves because of their unsuitability. In long-distance events only Serpollet gallantly kept the flag flying until 1905, though no 'classic' race had been won by steam since 1897 when a De Dion Bouton steam 'brake' had taken first place in Marseilles–Nice–La Turbie. The Land Speed Record was held by Serpollet himself for a short while in 1902, and four years later a Stanley steamer added slightly more than fifty miles an hour to Serpollet's 75·06 m p.h.

The years 1905 and 1906 saw Stanley Steamers making their mark in events staged on the beaches of the Florida coast, where the smooth sands were used for races up to five miles as well as for Land Speed Record attempts. The principal figure in these affairs was Fred Marriott who had been with the Stanley brothers since 1899, but F. E. Stanley himself took a hand (beating Walter Christie's famous front-wheel-drive racing car in 1905 for example), and Louis Ross in the 'Teakettle' covered the mile in 38 seconds to share with Bowden (Mercedes) and Macdonald (Napier) the honour of clipping Vanderbilt's 1904 record.



Fred Marriott and the 'Beetle'.
(Photo: Automobile Manufacturers' Association, Detroit)

Preparing for the attempt on the record, 1906; Marriott, in goggles, looks on.
(Photo: Automobile Manufacturers' Association, Detroit)

Taking the record: Marriott in action (Photo: Automobile Manufacturers' Association, Detroit)

Marriott in the 'Beetle' won the Dewar Cup Mile in 1906 at 111·8 m.p.h., against the 90 h.p. Napier and G. W. Young's 110 h.p. Fiat. On the next day (24th Jan.) he took the Five-mile Open Championship from Vincenzo Lancia in the Fiat. Lancia's time was 2 min. 54·6 sec., which Marriott cut to 2 min. 47·2 sec., or 107·65 m.p.h., thus comfortably disproving the theory that the steamer could not maintain full power for much more than a mile.

Journalists joined with the petrol car companies and their supporters in the game of claiming that the Stanley was a freak which should be barred. The cry of 'unfair' went up, but the 'Beetle' was rather less of a freak than many of the petrol cars. The basis of it was a slightly modified 20 h.p. boiler and running gear, with the normal type of Stanley horizontal two-cylinder engine of $4\frac{1}{2} \times 6\frac{1}{2}$ in.: the gearing was, admittedly, non-standard and at 1:1$\frac{3}{4}$ this engine revolved only 560 revolutions per mile. The boiler was placed at the back of the car so as to allow for a short sloping flue in place of the usual concealed, curved under-floor flue pipes of the standard cars; but the boiler was otherwise of the normal Stanley pattern, of 13 in. diameter with 1,476 tubes giving 265 square feet of heating area. At 800 lb. per sq. in. the indicated h.p. was 50 which could be maintained for ten miles; but for shorter periods double the pressure and nearly treble the output could be reached.

It was on the day after the Five-mile Open that Marriott and the 'Beetle' raised the Land Speed Record to 127·56 m.p.h. for the mile and, immediately after, to 121·57 for the kilometre. These speeds were nearly 20 m.p.h. faster than Bowden's had been in the previous year in the Mercedes, but the 'gasoline contingent' comforted themselves by proclaiming that as Bowden's claim had been disallowed on a technicality the Stanley had not really broken Bowden's record. Such curious reasoning defies analysis.

In January 1907 Marriott came back to Ormond Beach with a new and more potent Stanley and attempted to break his own record. The 'Wogglebug', later renamed the 'Rocket', was basically similar to the 'Beetle', with a comparable form of 'upturned boat' streamlined body, but with a boiler capable of maintaining 1,300 lb. per sq in. The attempt ended before the first run was completed, and consequently no time was officially recorded, but many of the onlookers had their stop-watches in action and it seemed clear that the car had comfortably broken the record when it struck a series of ridges in the sand, turned broadside, rolled over several times and disintegrated in the most spectacular and terrifying fashion. The boiler was ejected complete, but the driver was trapped under the wreckage; miraculously he was relatively little hurt, but the rest of the meeting was cancelled and the Stanley Company made no further attempts on the record.

A myth has long been accepted that the car had attained 197 m.p.h. immediately before the disaster, and in his old age Marriott himself came to believe in this and give it currency. Alas! it is no more than a myth but no doubt it will be impossible to dispel it now. According to F. E. Stanley's own stop-watch calculations and wheel-track measurements the car covered the first quarter of the mile in six seconds, and on this basis the speed for the whole mile would have been not less than 150 m.p.h. This would have been a remarkable enough advance on the 1906 record, and as the facts were given by F. E. Stanley's son, Walter, to the editor of *Automobile Quarterly* (by whose courtesy I am permitted to quote them), they are doubtless as near to the truth as one can hope to be.

After making token gestures of thankfulness at Marriott's escape most of the motoring press greeted the disaster, and Stanley's decision to withdraw, with ill-concealed relief and pleasure. Such sneers as, '. . .this intermittent space annihilator. . .capricious as a coquette. . . scant utilitarian value. . . caused the gathering to be a lamentable failure. . . as if glorifying (*sic*) in the havoc which it has caused the creeping mechanical being met with startling disaster. . .', and a good deal more in the same strain were a few of the epitaphs bestowed by those who doubtless thought of themselves as 'sportsmen'. But they could not dim the Stanley's star.

SPECIFICATION: 1900 LOCOMOBILE 'RUNABOUT'

Engine: two-cylinder, vertical, simple, double-acting. Dimensions 2$\frac{1}{4}$ in. bore, 3$\frac{1}{4}$ in. stroke. Output: 3$\frac{1}{2}$ indicated h.p. at 150 lb. per sq in. rising to approximately 12 h.p. at 300 lb per sq. in.

Boiler: Vertical fire tube. 298 13 in. tubes. Normal working pressure 150 lb. per sq. in.

Furnace: Petrol burning.

Water tank capacity: 15 gallons, operating range 20 miles.

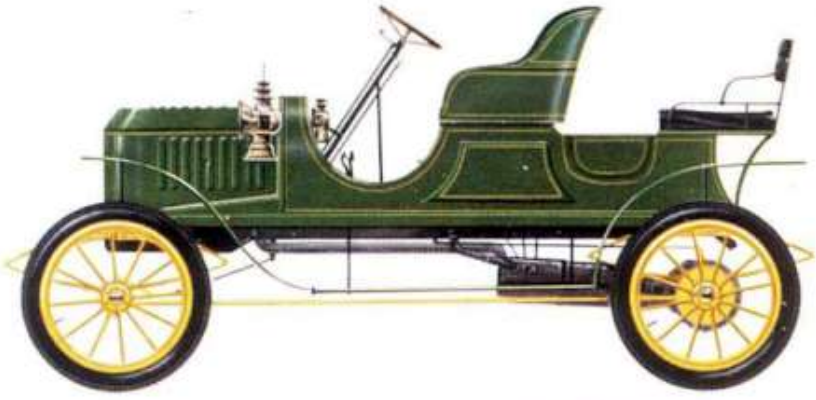
Valves: Slide. Stephenson's link motion.

Lubrication: To cylinders, by gravity from oil-cups, other parts lubricated by hand oiler or grease cup.

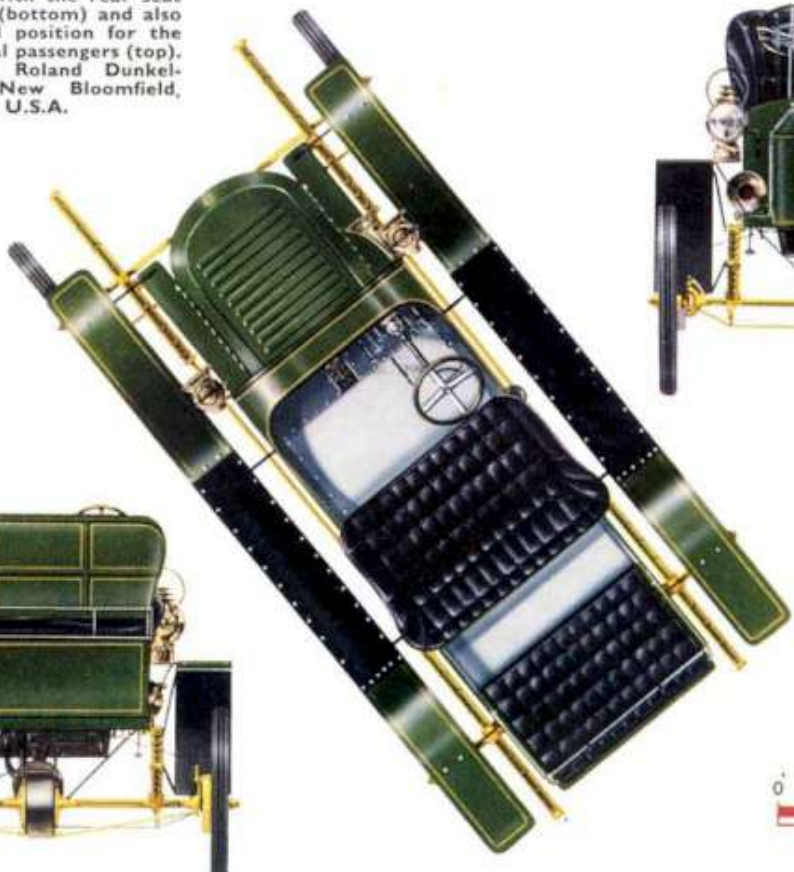
Transmission: By roller chain from crankshaft to differential live axle.

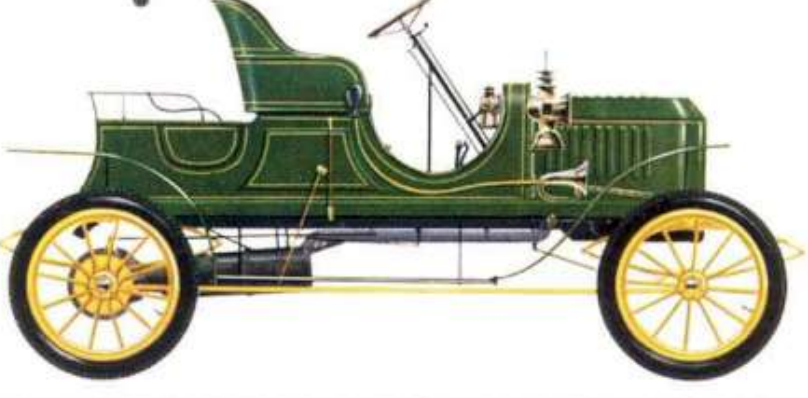
Brakes: One only, foot operated, contracting band on differential housing. Alternative braking by reversing valve motion, admitting steam and praying that the driving chain would not break or jump its sprockets.

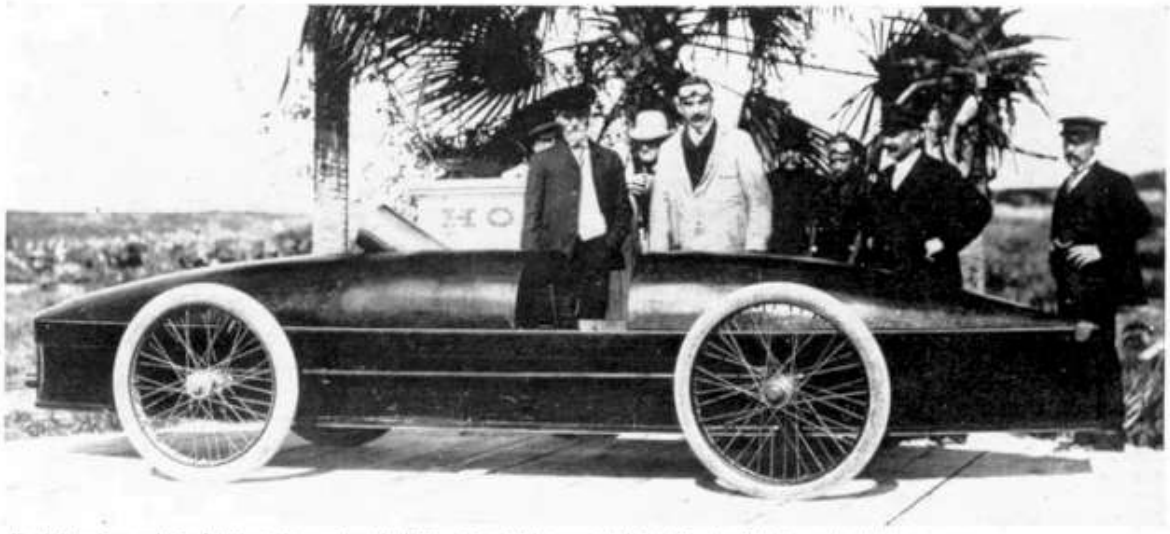
Stanley



THE 1907 MODEL EX STANLEY RUNABOUT. The car seated either two or four persons, and it is shown with the rear seat folded down (bottom) and also in the raised position for the two additional passengers (top). Owner: Mr Roland Dunkelberger of New Bloomfield, Pennsylvania, U.S.A.







Fred Stanley and Fred Marriott pose by the 'Wogglebug' (later called the 'Rocket') before the 1907 attempt.
(Photo: Montagu Motor Museum).

Steering: Direct-coupled tiller.
Chassis: Tubular steel underframe; all mechanical parts attached to wooden body structure.
Suspension: Single transverse full-elliptic leaf spring in front, and longitudinal full-elliptic leaf springs behind.
Wheels: Tangent spoked wire. Tyres. 26 × 2½in.
Dimensions: Wheelbase 4 ft. 10½ in. Track, front: 4 ft. 1¾ in.; rear: 4 ft. 2½ in.
Weight: Approximately 7 cwt.

SPECIFICATION: 1907 STANLEY MODEL EX.

Engine: two-cylinder, horizontal, simple, double-acting. Dimensions: 3 in. bore 4 in. stroke. Output: 10 indicated h.p. at 380 lb. per sq in. rising to approximately 28 h.p. at 650 lb. per sq in.
Boiler: Vertical fire-tube. 450 18 in. tubes. Normal working pressure 380 lb. per sq in.
Furnace: Kerosene burning.
Water tank capacity: 26 to 35 gallons according to body style. Operating range 40–50 miles.
Valves: Slide. Stephenson's link motion.
Lubrication: Automatic forced.
Transmission: By spur gear from crankshaft to toothed ring on differential gear of live axle.
Brakes: Foot, by contracting band on differential housing. Hand, by internal expanding shoes in drums on rear wheels. Emergency, by reversing valve motion and admitting steam.
Steering: Worm and wheel.
Chassis: Wooden with tubular steel underframe.
Suspension: Longitudinal full-elliptic leaf springs front and back.
Wheels: Wood spoked artillery pattern. Tyres 30 in. × 3 in.
Dimensions: Wheelbase, 7 ft. 6 in. Track, 4 ft. 8 in.
Weight: Approximately 12½ cwt.

All that was left: the geared-up (1¾:13) final drive mechanism and the relatively tiny cylinders may be clearly seen.
(Photo: Montagu Motor Museum)

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