Atkinson and Company, Frenchwood Works, Preston, Lancashire. later Atkinson-Walker Wagons Ltd.

The founder of this firm, Edward Atkinson, commenced operations in a garden shed at the home of his friend and partner, George Hunt, working mainly as a millwright. By 1908 Atkinson had been joined by his brother and they formed Atkinson and Company, the forerunner of the large internationally known organization now producing high grade commercial vehicles. Obviously a garden shed was too cramped for an expanding engineering business and so premises were taken at Kendal Street in Preston. This address gave access to the main A6 trunk road, and the partners were often called out to put right early motor vehicles which had broken down; from this activity it was only a short step to the repair of the steam lorries which used the road. Although the company undertook to repair any vehicle, they soon found that they were specializing in an undertype waggon made by Alley and McLellan, later to become the famous 'Sentinel', for which they were granted the agency. A second repair centre was opened in Liverpool to cater for the multitude of steam vehicles that operated in and out of the dock area. This company soon became well known as the premier repair firm in the North of England for steam road vehicles and when in 1915 the Sentinel agency lapsed, they branched out as manufacturers in their own right. By 1916, the first Atkinson waggon rolled out of the Kendal Street works and gained considerable success in a very short space of time; between 1916 and 1918, when the company moved to the specious new works spread over five acres behind Atkinson's home in Frenchwood, 125 steam waggons had been erected at Kendal Street.

However, the early successes of the waggon in the post-1914–18 period of economic prosperity were soon diminished. With the advent of the 1923 depression the company was forced to declare part of its labour force redundant as the sales fell and production dropped off. After 1924 the design of the Atkinson waggon remained virtually unchanged and the combination of these factors reduced the firm to a very shaky position. When business had been good, Atkinson had turned down an offer of £75,000 plus an assured post of Managing Director for life from the Foden company, stating at the time, 'If it's worth all that money to them, then it's worth more to me'. It was a pity that the merger did not take place for if Foden had gained a sound, proved undertype design capable of being further developed, the history of steam driven commercial vehicles may ha been changed radically.

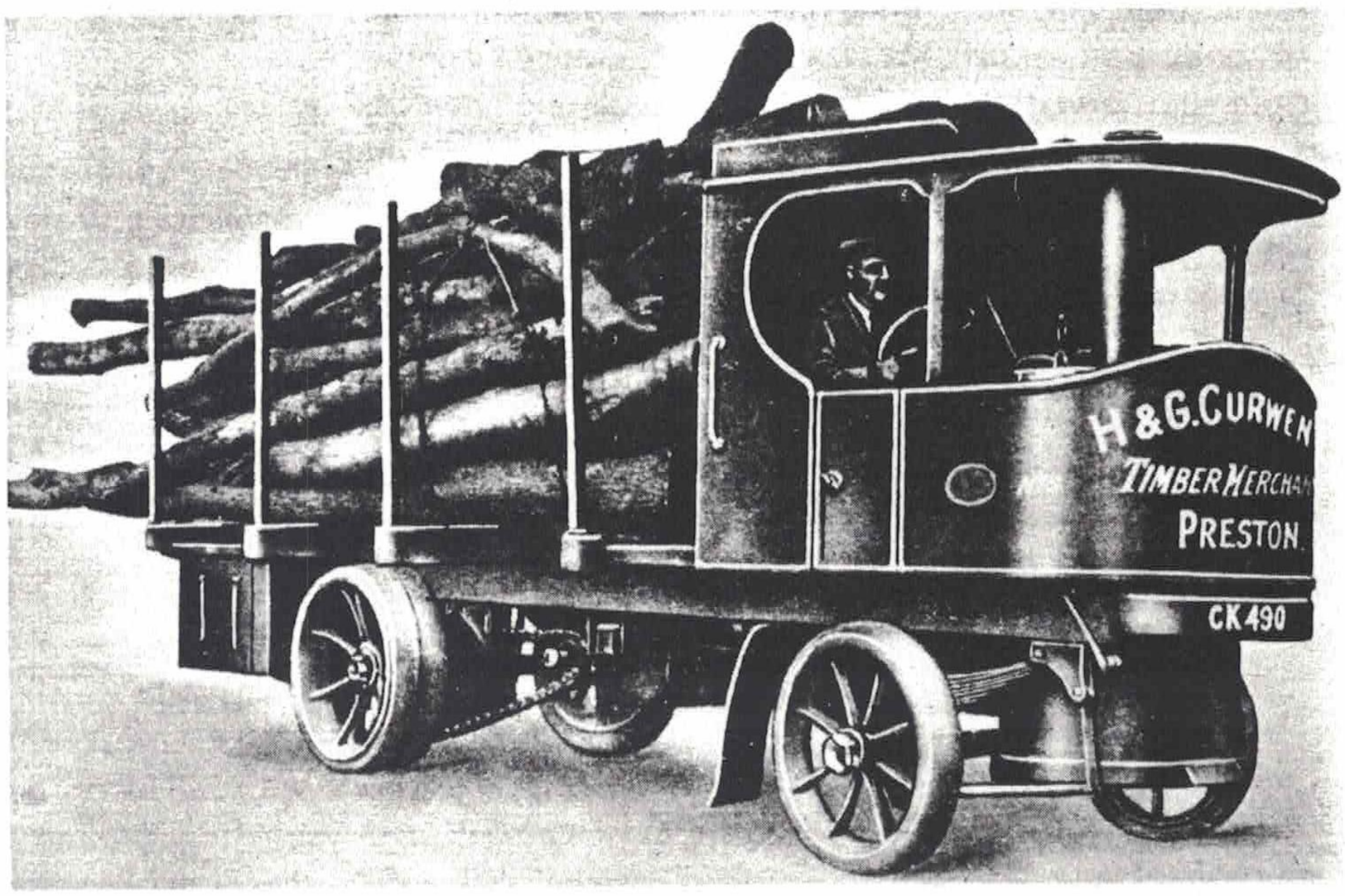
In 1926 a link-up was negotiated with a maker of mini machinery, Walker Bros (Wigan) Ltd, Pagefield Foundr Wigan. The new company was entitled Atkinson-Walk Wagons Ltd, and they carried on business at the sa address as before, continuing the production of steam wa gons until 1929 as well as a new joint product, the Atkins railway locomotive. This venture did not go too well Walkers never received any interest on their capital, the r loco lost money, sales made on hire-purchase had to re-possessed and the recovered waggons, being virtua unsaleable, caused a grave loss. Finally Walkers pulled o leaving Atkinson to go into voluntary liquidation late 1930. Luckily the receiver managed to sell the compa still as a going concern (only twelve employees were le and the new owners, by struggling on with repairs to existi waggons, sales of spares etc., managed to pay off the ba and develop their new oil-engined lorry. In 1933 a Lond business man, W. G. Allen, bought the firm from the bank successors and the resulting concern that emerged under h leadership, Atkinson Lorries (1933) Ltd, grew into t modern firm of Atkinson Vehicles Ltd, having subsidia branches in every important overseas market. Edwa Atkinson, who had played an increasingly small role in t affairs of the company from 1925 onwards, lost control 1930 but was re-elected as a director of the new firm in 19 although he took no active interest in its organization. H died on 9 January 1932 at his house in Frenchwood afte period of ill-health.

In 1915, when the decision was taken to produce stea waggons of their own, J. Haythorn was invited to becor Atkinson's designer, having held a position on the desi team responsible for the 'Sentinel' at Alley and McLellar Haythorn's waggon was very reminiscent of the Scotti product, though various detail improvements set it apa from the usual run of undertypes being sold at the time. T first lorry was completed in January 1916 and it was run trade plates until it was sold to H. and G. Curwen a Company in the April, when it was registered as CK 4 Works No. 1. During these four months the waggon w used by the company for testing and evaluation purposes a the fuel and water consumption together with engine pe

formances were recorded. Any design modifications necessary were made before delivery to the customer but, apart from the fact that the cab was evolved during this time instead of being designed beforehand, these modifications (if any) do not appear to have been recorded. In these early Atkinsons much of the work was put out to other firms; for example, all the boilers were made by Messrs Joseph Adamson of Hyde, Cheshire, who supplied them to Atkinson's design but undrilled, Whiteheads and Coulthards did most of the foundry work, with the latter firm also doing the case-hardening, whilst the remainder of the castings, being of steel and not obtainable locally, came from Braintree.

The boiler of the first type of 6-ton waggon was a vertical, water-tube unit with the tubes mounted across the fire-box. These tubes, of which there were 56, were disposed in eight rows of seven, each row being at 90° to the one above it; at the point where the tubes were fitted, the firebox was fabricated into a square shape. The dimensions of the tubes were $1\frac{5}{8}$ in. O.D. × 10 s.w.g. with the length varying from $17\frac{1}{2}$ in. to $20\frac{1}{2}$ in. from top to bottom. The design of the boiler was made to do away with as many rivetted joints as possible and, after about fifteen or so units had been produced, the rivetted foundation ring used was discontinued and the inner firebox was welded by acetylene on all subsequent ones. The construction of this boiler was simple; above the two firebox openings, for firing and clinkering respectively, the whole of the outside barrel fitted on two flanged joints like a top-hat. The bottom flange, turned outwards was secured by sixty, $\frac{5}{8}$ in. Whitworth nuts and bolts, and the top flange had a ring of 40 $\frac{5}{8}$ in. studs projecting from the firebox. To facilitate removal of the outer part for tube inspection or cleaning, however, was not as easy as it would seem for the cab roof as well as the floor plates had to be removed first. Fitting over the firebox opening there was a cast iron conical cover containing the uptake neck for the funnel with the exhaust pipe entering at the front and turned upwards to promote the draught. From this cover the superheater was supported by two lengths of studding from the cast iron uptake. The superheater itself consisted of ten coils made from a 30 ft. length of solid drawn steel tube of $1\frac{1}{4}$ in. outside dia.; a 9 in. dia. baffle plate was placed above the coils to force the hot gases to circulate around the superheater. The firing opening was flush with the footplate, having a cover which was removable in the earlier waggons and hinged in the later ones from about 1923 onwards. When the fuel entered the firebox it tended to spread itself evenly about the grate and so needed little attention apart from replenishment every mile or so.

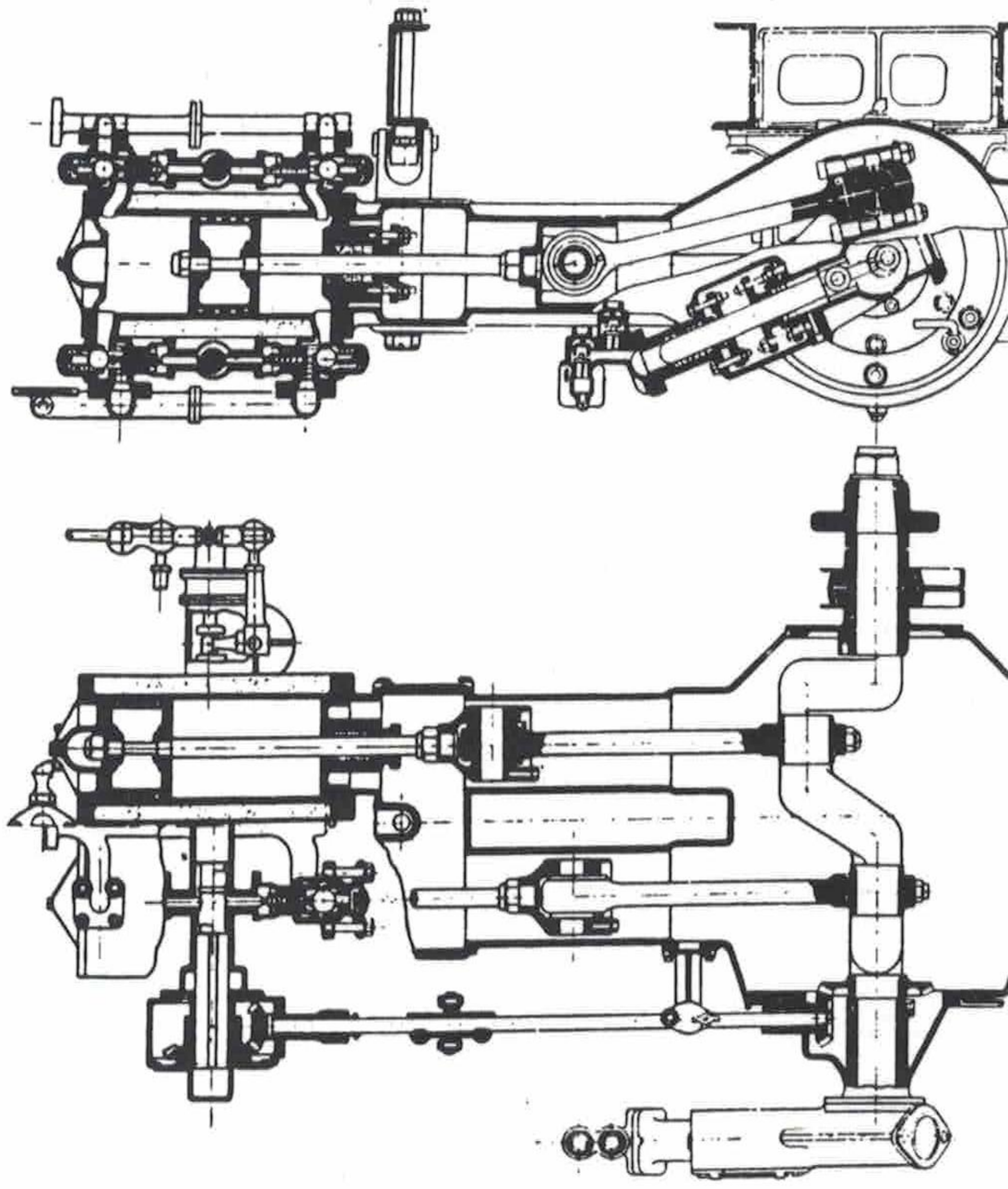
The boiler measured 4 ft. 9 in. high and 2 ft. 6 in. outside dia., was lagged with asbestos, and was clad in blued steel sheeting secured with brass bands; its mountings consisted of a safety-valve, three wash-out plugs in the bottom water space set at 120° to each other, a filling plug, a flexible pipe and nozzle for blowing soot from the tubes, a blow-down cock, water gauges, and a funnel blower, etc. These boilers were capable of being forced without priming and proved in service to be robust and longlived; in fact, one was reported to have continued without being de-rated for twenty-six years. Originally a grate area of 3·0 sq. ft. and a heating surface of 55 sq. ft., working at 200 p.s.i. and 540 °F of superheat was the performance of the boiler, but with the introduction of more powerful engines these figures were increased to 3·3 sq. ft., 60 sq. ft., 230 p.s.i. and 580 °F respectively by increasing the number of tubes to sixty-three, the outside dia. of the shell to 2 ft. 9 in. and the provision of a triple coil superheater replacing the twin coil one. On some



13. The first Atkinson 'Standard' undertype steam waggon to be produced. This was Works number 1 and was supplied to H. and G. Curwen of Preston in May 1916.

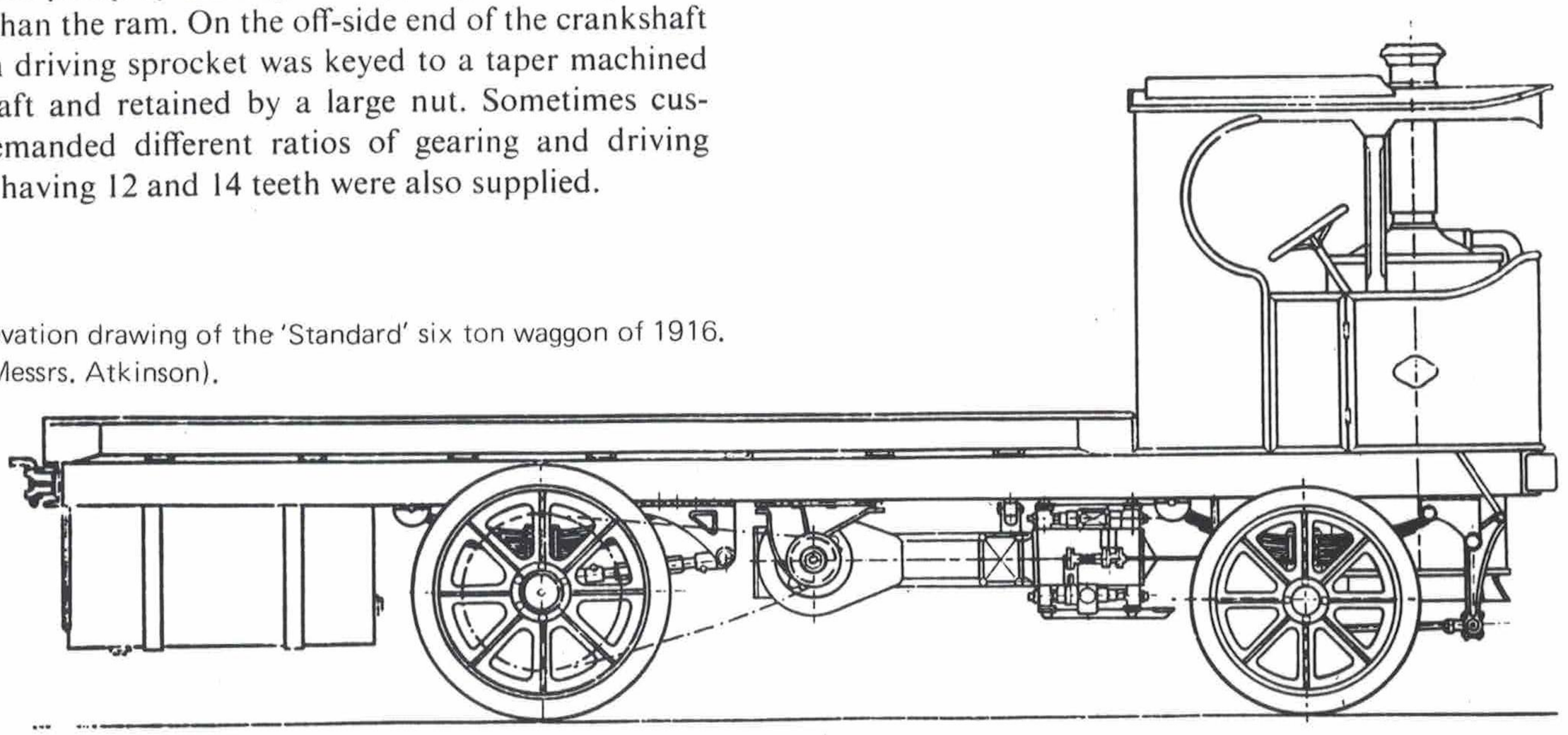
of the smaller waggons which were sold from time to time the number of tubes was reduced to forty-eight, but the basic design of boiler was retained throughout the whole range of vehicles from 1916 to 1929. Good gas coke was considered to be the best fuel but Welsh steam coal could be used if the greater amount of dirt concerned with its use could be tolerated.

The engine of the 'Standard' waggon, as it was called, was a double-acting duplex unit having a bore of $6\frac{3}{4}$ in. and a stroke of 10 in., running at a maximum of 300 r.p.m. Although there was a likeness to the Sentinel design, Haythorn's engine had certain differences, particularly in the admission and exhaust valves which were hardened steel balls, spring loaded against their seats and operated by two bevel-driven camshafts, one above the engine controlling the inlet valves and one below to control the exhaust valves. Three cams on each shaft gave the two ahead cut-offs of 50 per cent and 70 per cent and the reverse of 75 per cent, in addition there was a mid-gear position in which no cams were used, provided for warming the cylinders through before starting. The bevel shaft driven off the crankshaft was mounted on the near side at a slant. The ball valves were claimed to be self-seating as they tended to revolve on their seats in service, continuously grinding themselves in. A small oil pump lubricated the upper cambox and all the other bearings were splash lubricated from oil in the crankcase. On the nearside, at the end of the crankshaft, there was a ram type, single-acting boiler feed pump, $1\frac{1}{2}$ in. bore $\times$ $1\frac{3}{4}$ in. stroke and operated by an eccentric pin. The ram worked in two glands, one retaining the oil in the eccentric housing and the other sealing the water side of the pump. The pump body, which had a door to adjust the glands, was made of cast iron whilst the connecting rod was cast steel with a bronze bush at the big-end. The glands were relieved of side thrust in this pump by making the slipper guide of a greater diameter than the ram. On the off-side end of the crankshaft a 10-tooth driving sprocket was keyed to a taper machined on the shaft and retained by a large nut. Sometimes customers demanded different ratios of gearing and driving sprockets having 12 and 14 teeth were also supplied.



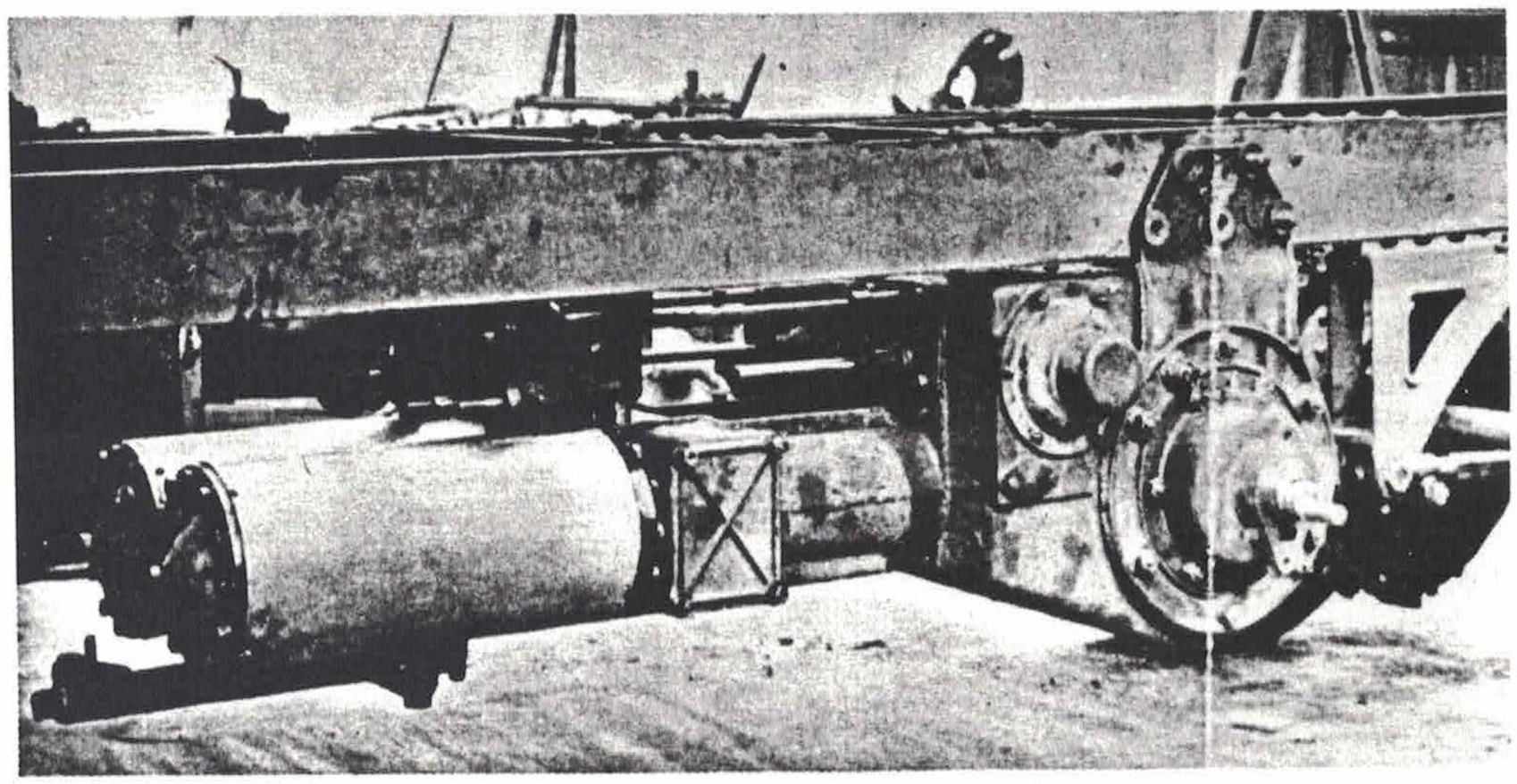
14. Elevation and plan of two-cylin
'Standard' engine. The twin camsh
layout as used in Atkinson wagg
until 1919 was very similar to
Sentinel design. (Courtesy Messrs. Atkinso

The framing was built up from channel section steel 7
$\times$ 3in. $\times$ $\frac{3}{8}$ in., running the whole length of the vehicle
spaced by five cross-members reinforced by triangu
gusset plates. All the running gear, engine, boiler w
carried on this framing, which also provided the base
carry the body. The suspension system consisted of se



15. Side elevation drawing of the 'Standard' six ton waggon of 1916.
(Courtesy Messrs. Atkinson).

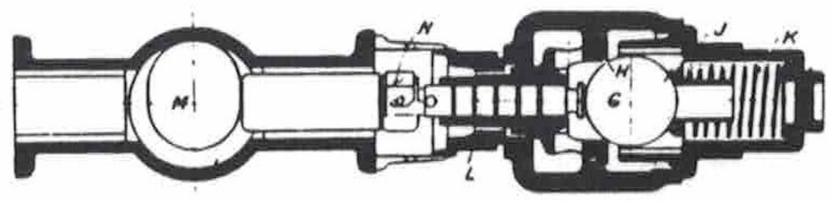
16. The Atkinson 'Standard' engine unit.



elliptic leaf springs all round, the front ones having 11 leaves, the top leaf being pinned to the steering bracket on the offside, an ordinary bracket on the nearside, and free to move longitudinally in a slipper guide. At the rear both ends of the springs were free to move but were held together in clamps. Cast steel road wheels with spokes of cruciform section were used and all the waggons produced by Atkinson were sent out fitted with rubber tyres. The front axle was a 4 in. steel tube carrying special castings at its ends to provide spring seats as well as bearings for the king-pins. The stub-axles were drop forgings of T-section, with the offside one having a cast steel lever bolted to it to carry the ball joint for the draglink; short track rod levers fitted into holes in the bosses of the swivels and were retained by locknuts on their forward faces. By inclining the stub axles slightly, the steering was given a good castor action. The track rod itself was retained on the levers by pins, whilst the other steering joints had ball-ends with adjustable brasses. The road wheels had bronze inserted bushes and they were held on the stub axle by collars fitted over the end of the axles and pinned through them. The steering gear was of the screw and nut type which pulled two rods either side of the steering box up or down and so transmitted motion to a large cast bell-crank in a fore and aft direction. This system appears to have been used by other undertype waggon makers, noticeably Sentinel and Clayton. The rear axle carried the final drive as well as the braking system; the former comprised the differential gear which was made in two distinct parts.

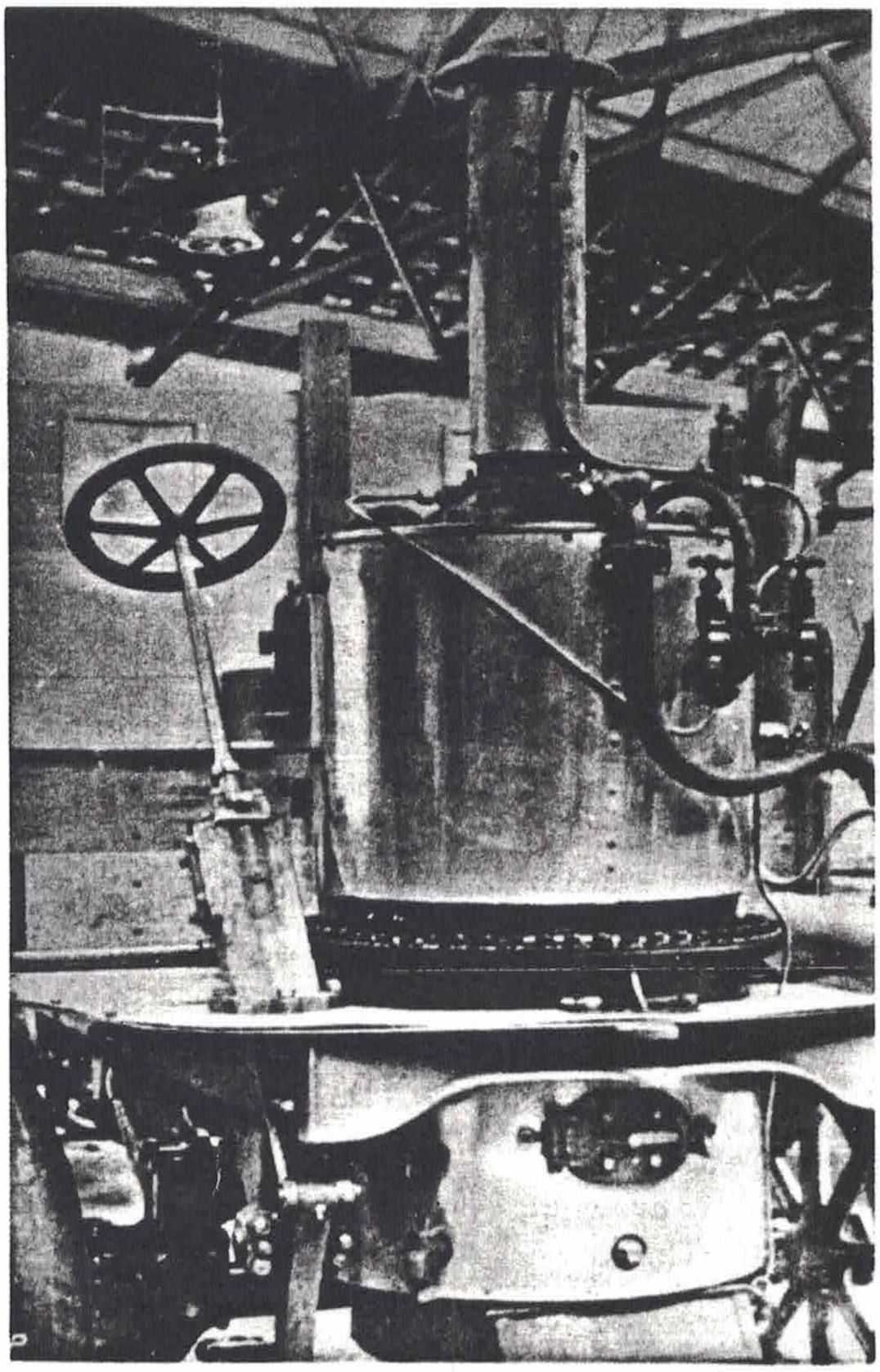
The first part consisted of the driven sprocket, having thirty-two teeth or sometimes thirty-three, being mounted on to the axle by a bushed bearing with the wheel located axially between the axle collar and the sleeve on the differential; on this sprocket the brake drum was attached by bolts, some of which protruded through to hold the case-hardened pins on which the differential pinions ran. The other part of the system concerned the differential wheels,

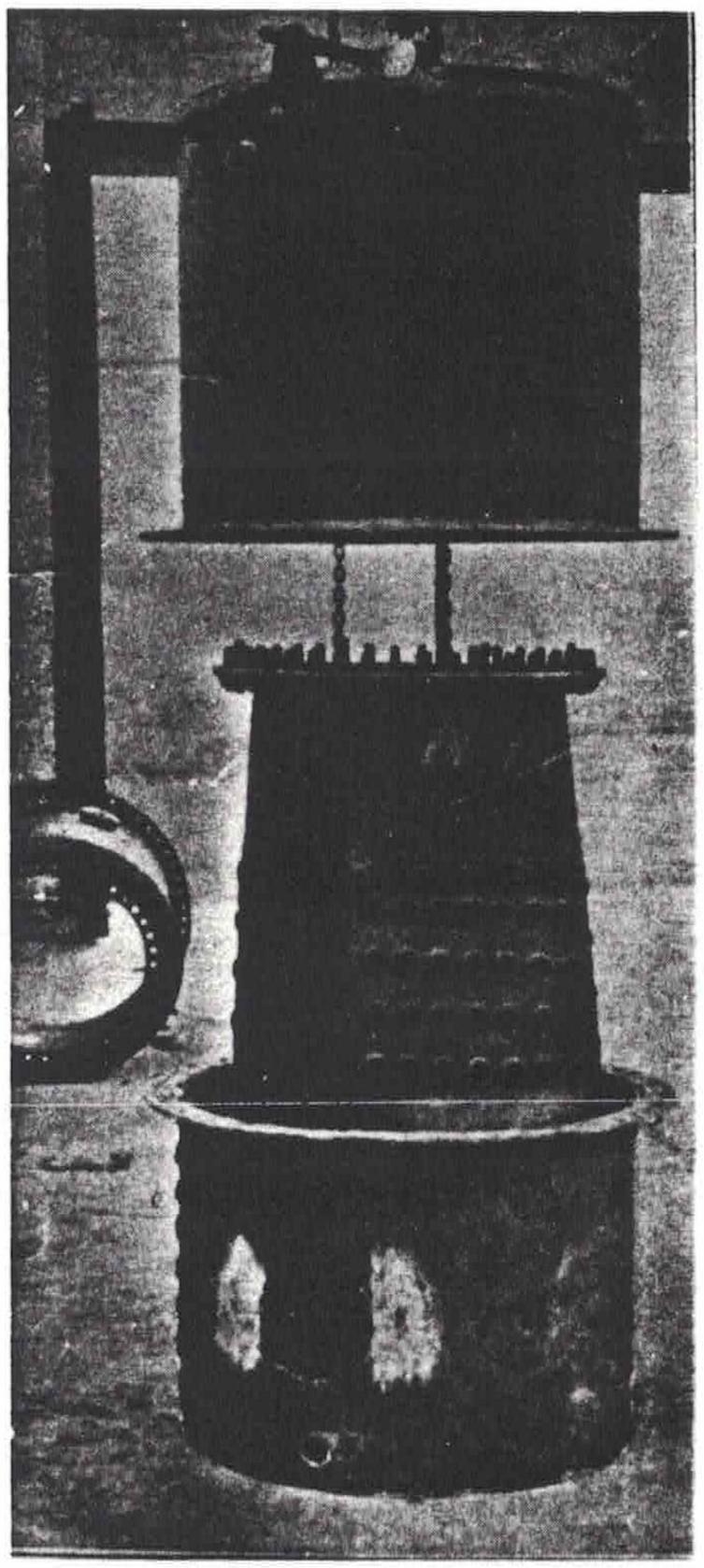
17. Detail of the patent ball valve, showing cam, tappet and push rod. This design was later used for the admission in the 'Uniflow' engine. (Courtesy Messrs. Atkinson).



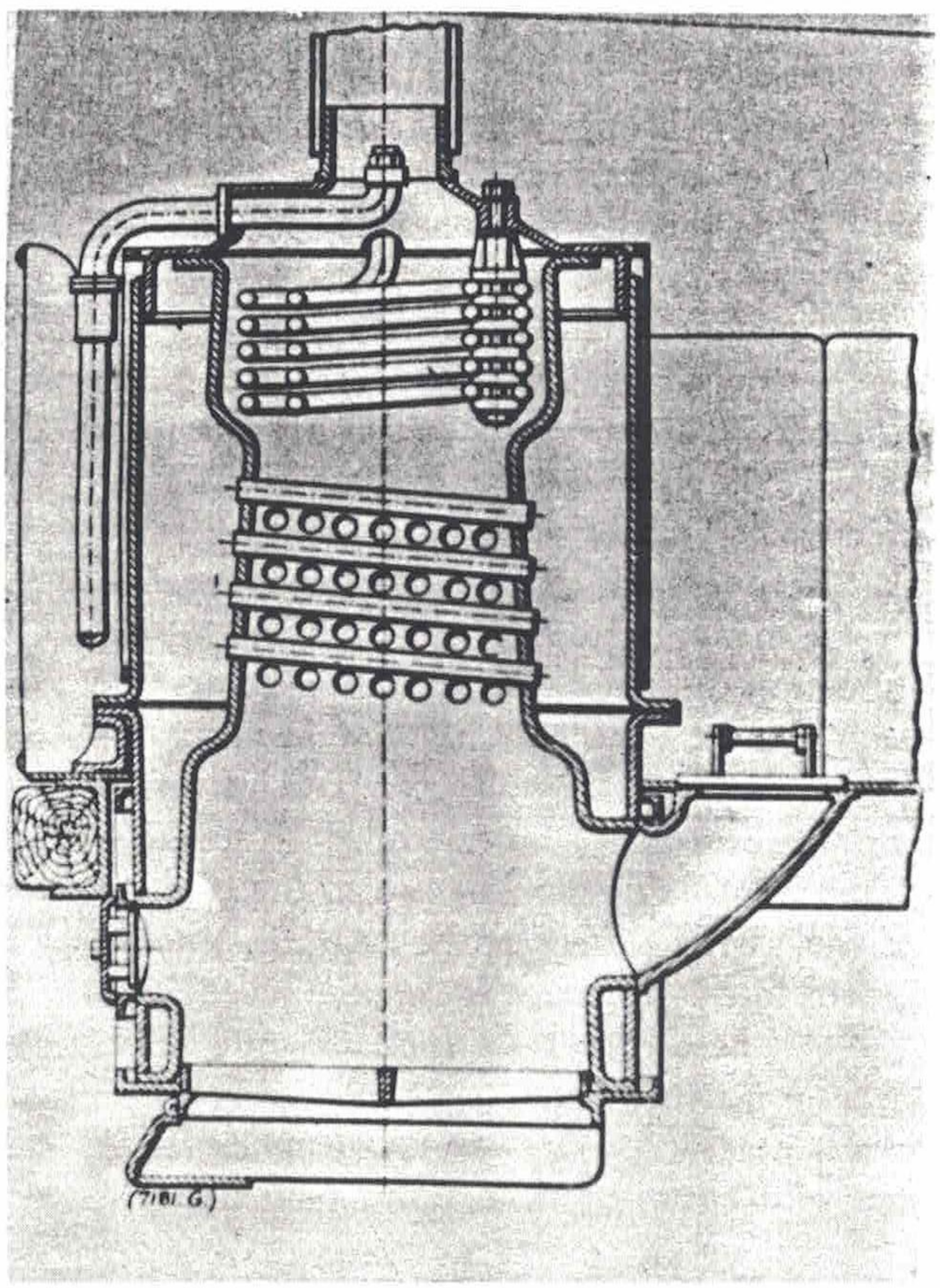
one of which was bolted to a flange on the axle, with the opposite one bolted to a corresponding flange on the sleeve. A pressed steel gearcase held on by the brake drum bolts kept the differential unit free from grit and dirt and ensured that grease remained packed around the gears. The nearside rear roadwheel fitted on to the axle by taper, key and locknut, while the offside one fitted on a taper on the differential sleeve, and had driven through bolts which secured it in place. The braking of the waggon was effected by either reversing the engine or using the steam brake fitted to the sprocket. The drum $20\frac{1}{2}$ in. dia. and $3\frac{1}{4}$ in. wide, had an external Ferodo lined contracting band actuated by a 6 in. dia. steam cylinder which, when applied by means of a cock in the cab, produced quite good stopping effects. A screw-down hand-brake, operating the same band through a wire cable, provided an independent means of braking. Unfortunately these steam brakes were seldom used by drivers who preferred to slip into reverse to stop, and so they seized up either through lack of lubrication or disuse; finally the shed fitters used to remove them altogether. The axles ran in cast-steel axle boxes clamped to the rear springs and bored out to take a 5 in. dia. bronze bearing which was oiled by spring-loaded felt pads. On the nearside the axle ran in the bush, but on the offside the sleeve seated in the bearing. The various stresses present in driving axles were all allowed for in this design, although the earlier axles, made of mild steel, were prone to fracture at the point of attachment of the fixed differential wheel; side thrust was taken up by flanges on the bearings, whilst driving and braking loads were checked

18. Atkinson boiler fitted to the 'Standard' chassis. On the right is shown the boiler dismantled for inspection.





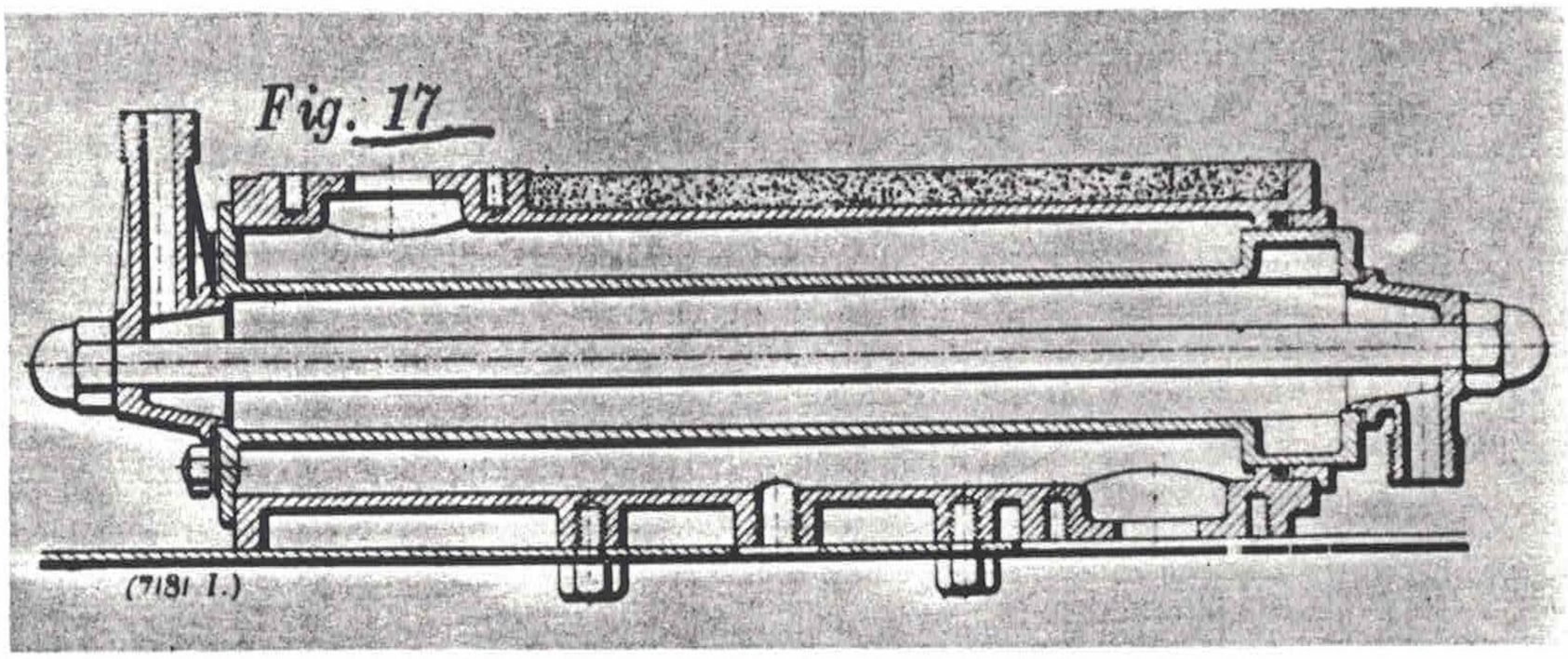
19. Earliest form of boiler used by Atkinson.



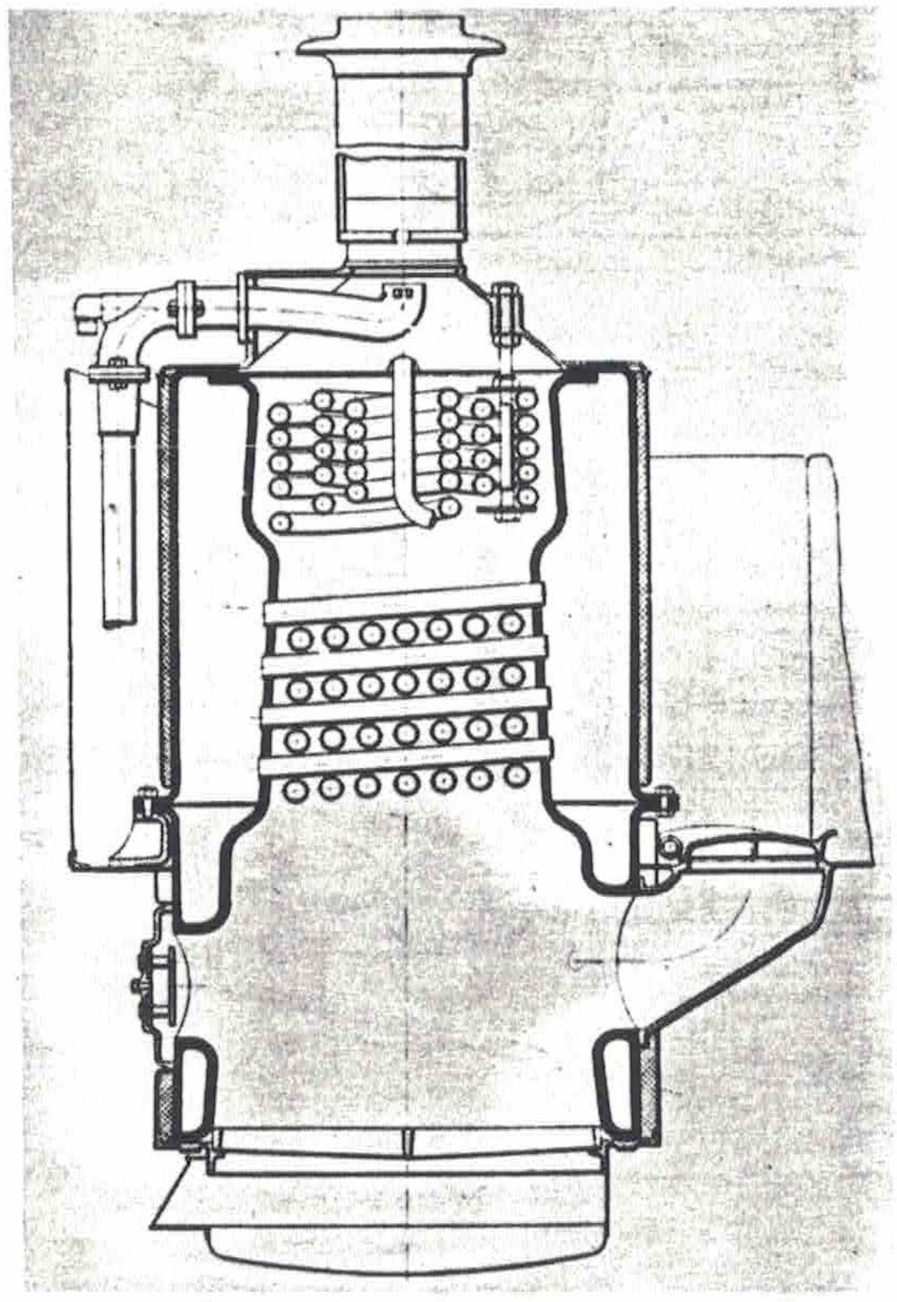
by the radius arms which were adjustable for chain tension and axle location within small limits. The axle breakages previously mentioned were eliminated when they were made of nickel-chrome steel; when the mild steel axles broke, luckily they usually stayed together, enabling the driver to get the waggon home.

The controls of the Atkinson 'Standard' waggon consisted of a stop valve mounted on the right-hand side of the boiler with an interconnected foot release valve, the steam braking cock, steering wheel, screw-down handbrake, and the reversing lever which had four notches on its quadrant marked Forward, Fast, Stop and Reverse. The subsidiary controls, including a 3 mm. injector, were all arranged so as to come easily to hand. The feed-water system was controlled either by regulating a bye-pass valve on the continuous acting pump when on the road, or by using the injector when stationary. Both the injector and the boiler check valve were duplicated with screw-down valves should either non-return valve stick or leak; the feed-water heater was also fitted in the cab on the left-hand side of the footplate. The waggon was driven in a similar manner to other makes of undertype steam lorries though one factor that often caught

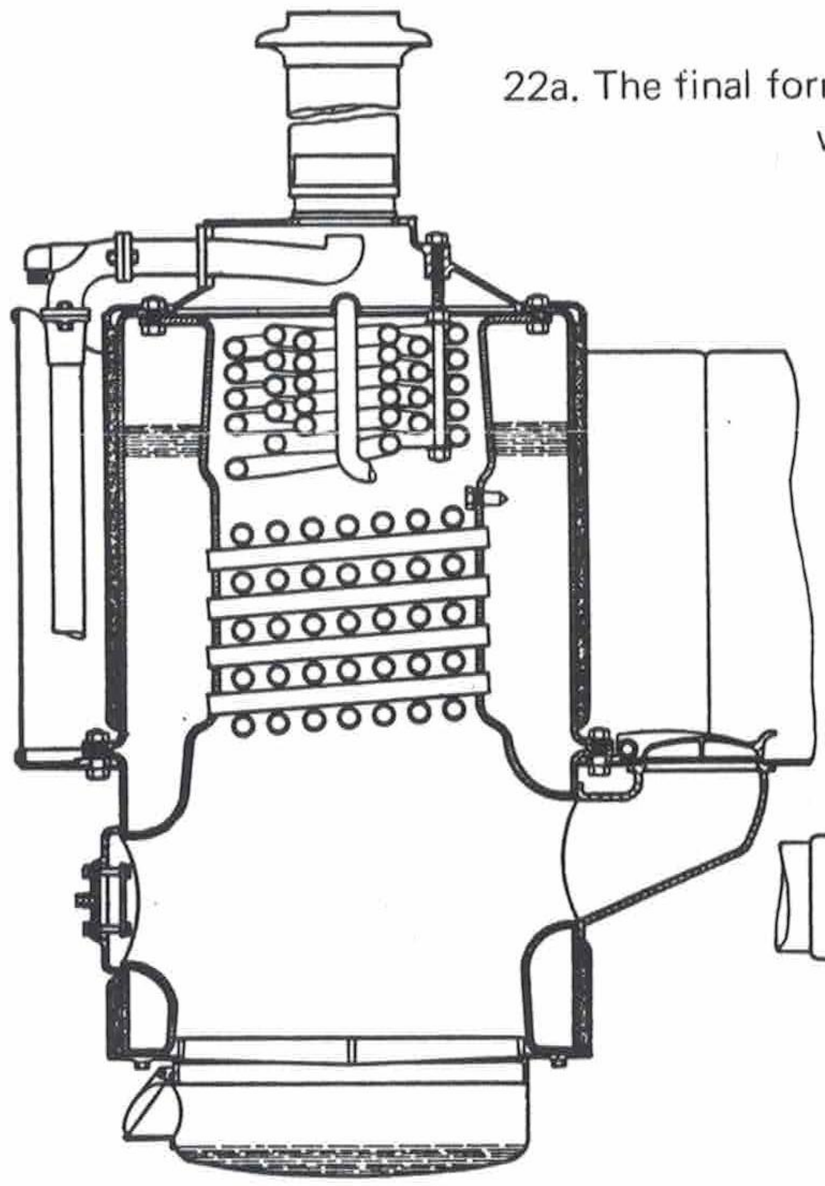
20. Early type of feed water heater used on the 'Standard' waggons.



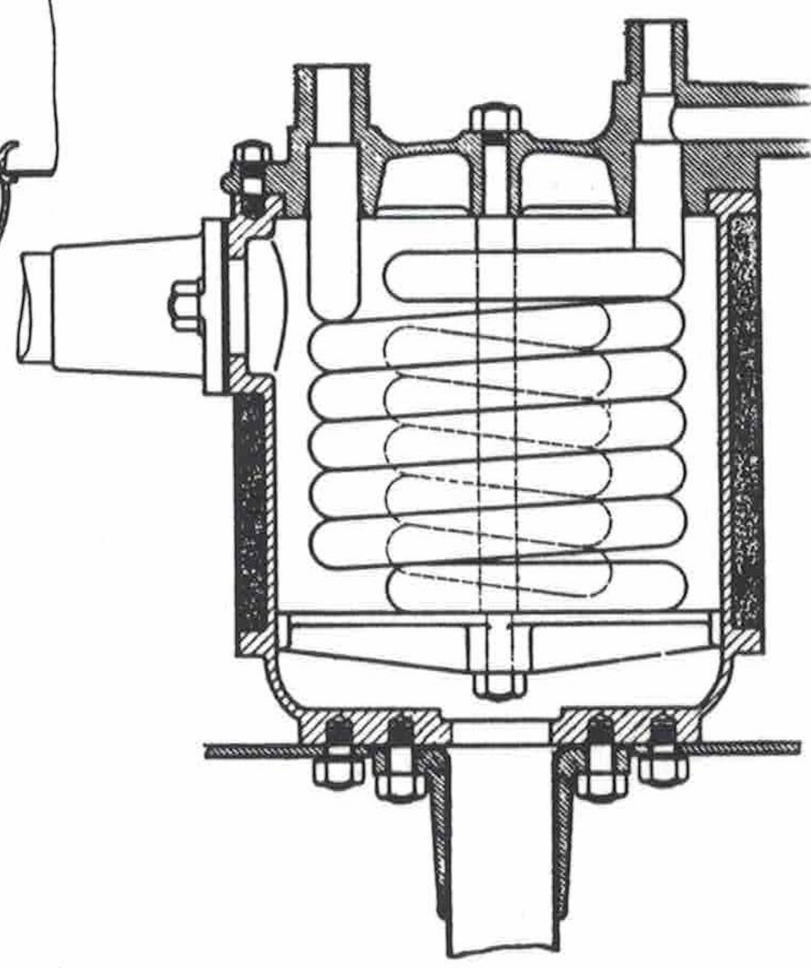
21. Later form of Atkinson boiler used in the 'Uniflow' waggons.



22a. The final form of water tube boiler with patent side firing.

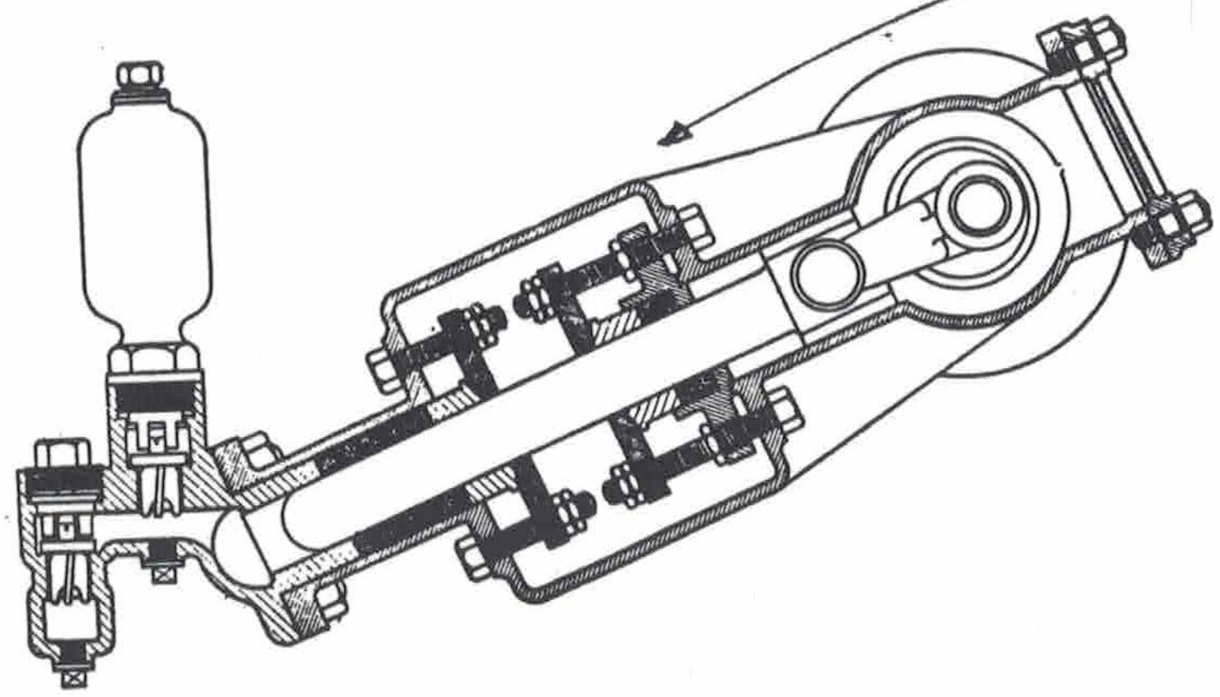


22b. Twin coil feed water heater which was mounted in the cab on the nearside.

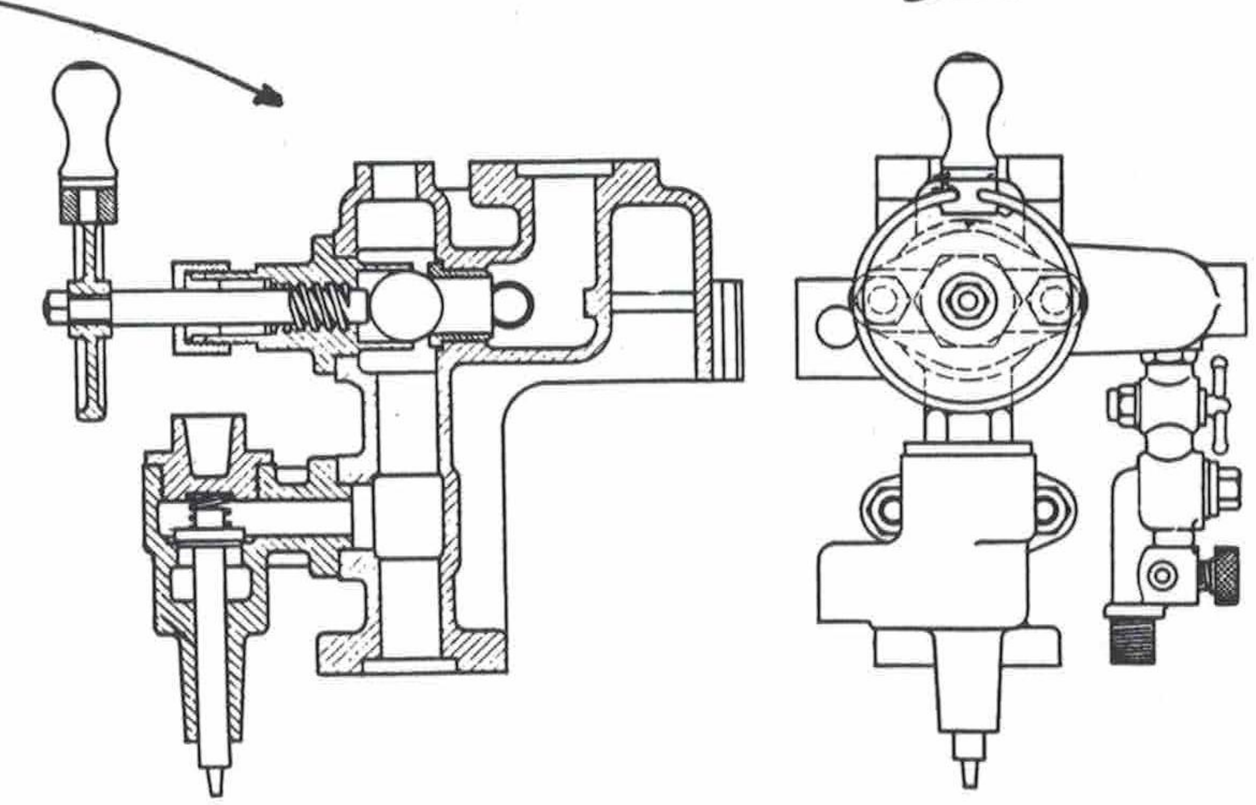


Drawings courtesy Messrs. Atkinson.

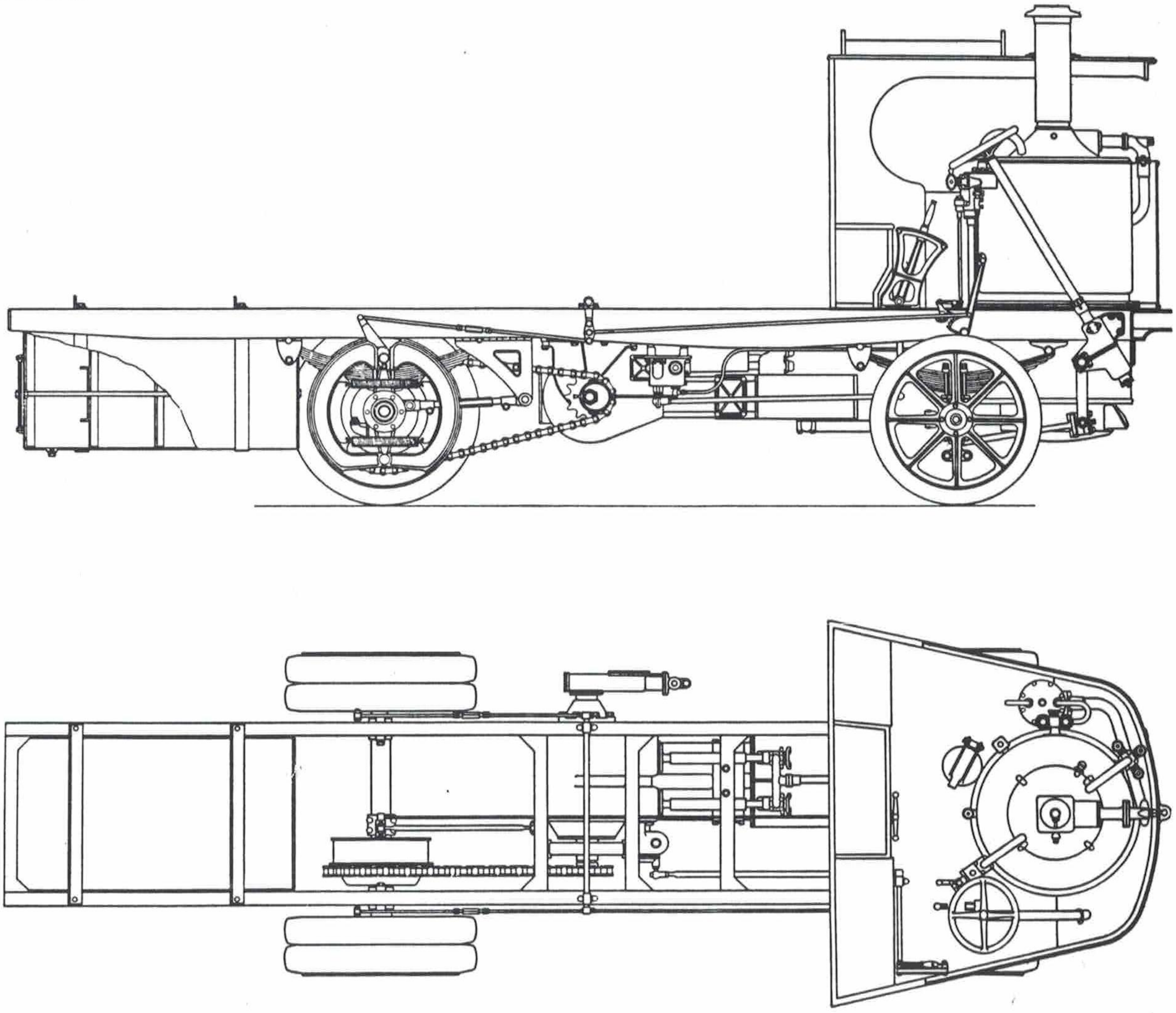
22c. The regulator valve.



22d. Section of the 'Uniflow' feed pump



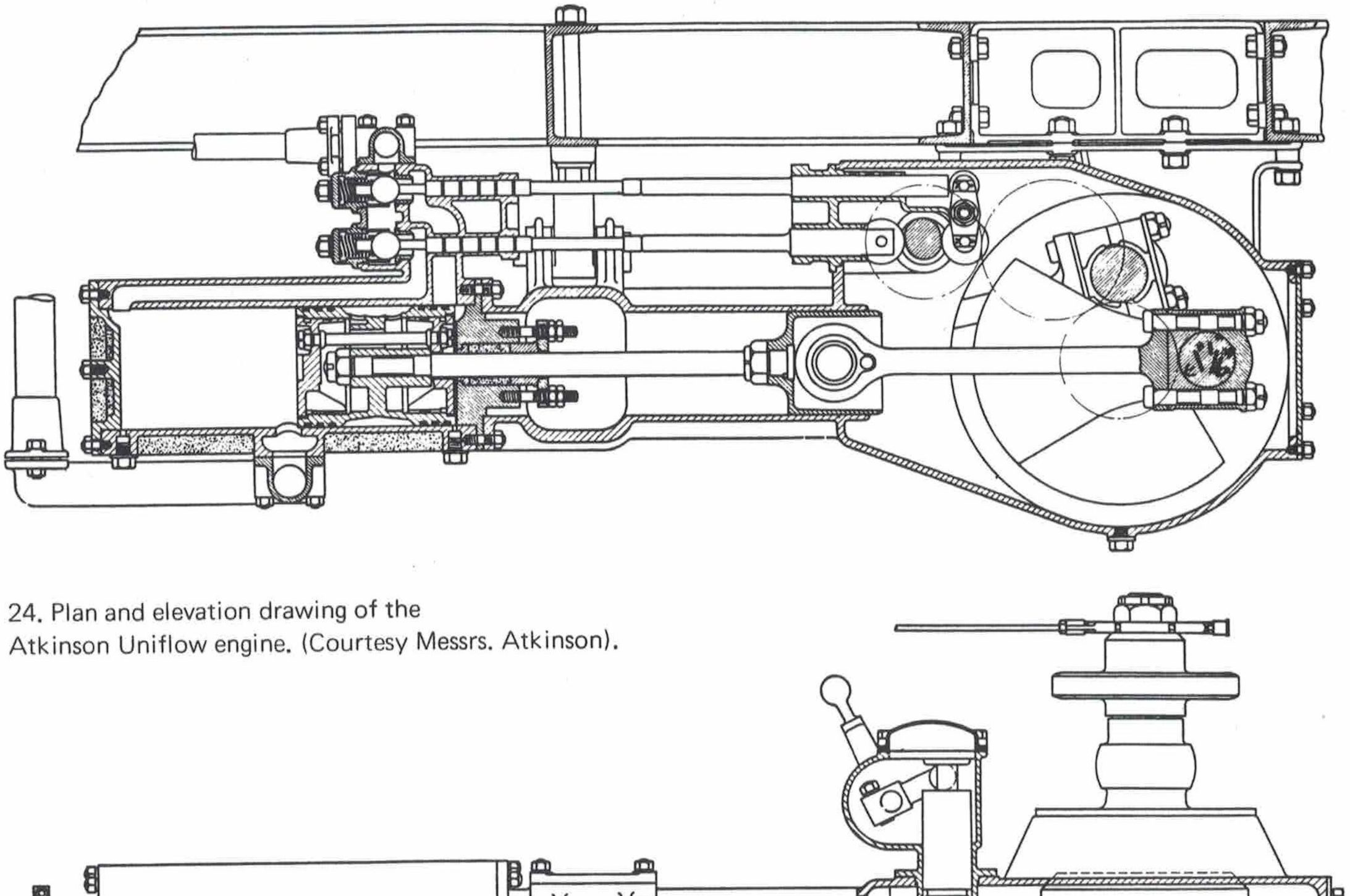
23. Outline drawings of the Atkinson Uniflow steam waggon.
(Courtesy Messrs. Atkinson).



out drivers who were not used to handling the Atkinson was the mid-gear or stop position of the reversing lever; this did not put an equal pressure of steam on both sides of the piston as was usual, say, on the normal overtype, but opened all the valves at once, allowing the steam to pass through the engine whilst a spring-loaded valve in the exhaust system, operated from the cab, prevented water pouring over the tubes via the blast pipe when the lever was in this position. It therefore was no use for the driver to put the engine in mid-gear and hope that the waggon would stop; it had to be put in reverse for that effect.

This Atkinson model carried a large tank, slung between the frames at the rear on the platform bodies and behind the cab on the tippers, containing 170 gals. of water. A complete set of tools together with a 30-ft. length of 3 in. dia. armoured water hose was supplied with each unit and the price for the complete waggon painted to the customer's requirements was £1,170.

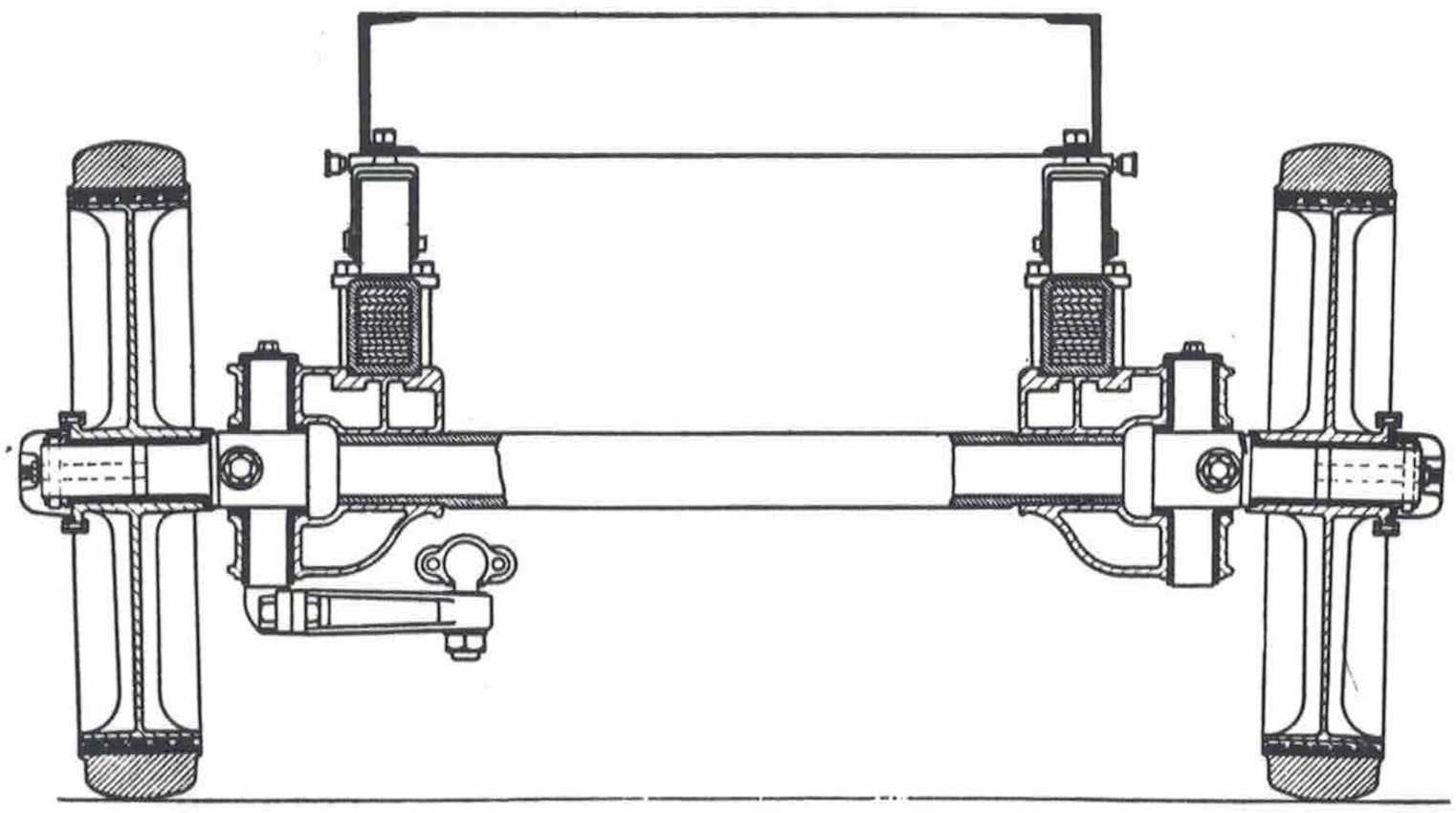
The first tipper constructed by this firm was delivered in September 1916 to Messrs J. H. Martin, Coal Merchants, of Preston and was numbered on the works register No. 10; it was a 4-ton machine and it incorporated Atkinson's special steam tipping gear. This tipping system consisted of an auxiliary steam engine mounted on the side of the framing, driving a vertical screw jack through chain and worm gearing. The method of operation was as follows: the small vertical engine having two cylinders of $2\frac{1}{2}$ in. bore and 2 in. stroke, was slung from the underside of an angle bracket attached outside the frame on the offside just behind the cab. The crankshaft of this engine was parallel to the centre line of the vehicle, and it had a three-start worm machined at its centre which meshed with a 28-tooth worm wheel. On the outer end of this worm-wheel shaft there was a sprocket which drove a similar sprocket on the transverse drive shaft which was carried in a cast-steel bridge extending across the framing. This bridge swelled out at its centre to give clear-



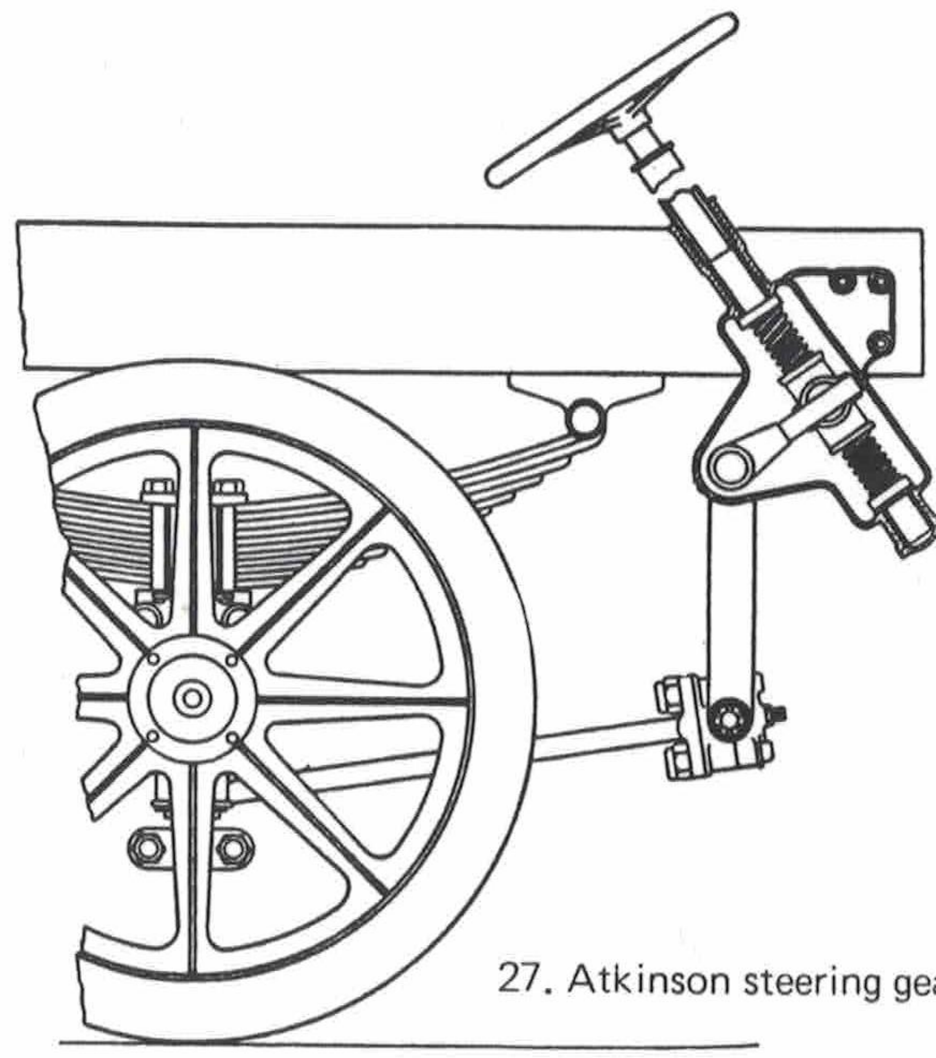
24. Plan and elevation drawing of the Atkinson Uniflow engine. (Courtesy Messrs. Atkinson).

ance to the casing containing three bevel gears, which was mounted on trunnions to adopt the angle of the body when tipping; one bevel wheel was attached to the engine-driven transfer shaft, another, in the same plane, to a further transfer shaft on the nearside supplied for manual operation, whilst the third drove a vertical screw shaft which engaged in a nut at the end of another hollow screw which enclosed the first one. A tubular outer cover was provided to keep the telescopic screws clean and this was fitted with limiting stops to prevent the gear from over-winding; the lower end of this tube possessed a fitting which transmitted thrust to a bracket bolted to the end of the tipping body. The tipping engine itself was of simple design having plain piston valves without lap or lead and being operated by eccentric pins inserted on the outer crank throws (Fig. 28). These were set at 90° from the crank, thereby admitting steam for the complete stroke. If it was required to reverse the tipping gear, a special piston control valve actuated by a small hand lever could admit steam either to the ends of the valves or to the annular space between the ends while simultaneously the exhaust ports were changed relatively to the admission ports. This tipping system was very fast and efficient for the purpose of getting rid of the load but it was exceedingly extravagant with steam; one tipping operation could cause a drop in pressure of 100 p.s.i.

In 1919, experimental work was continued on a new form of engine which had commenced in 1917 but had been dropped because the works had been moved from Kenda Street to Frenchwood. This unit was the now famou

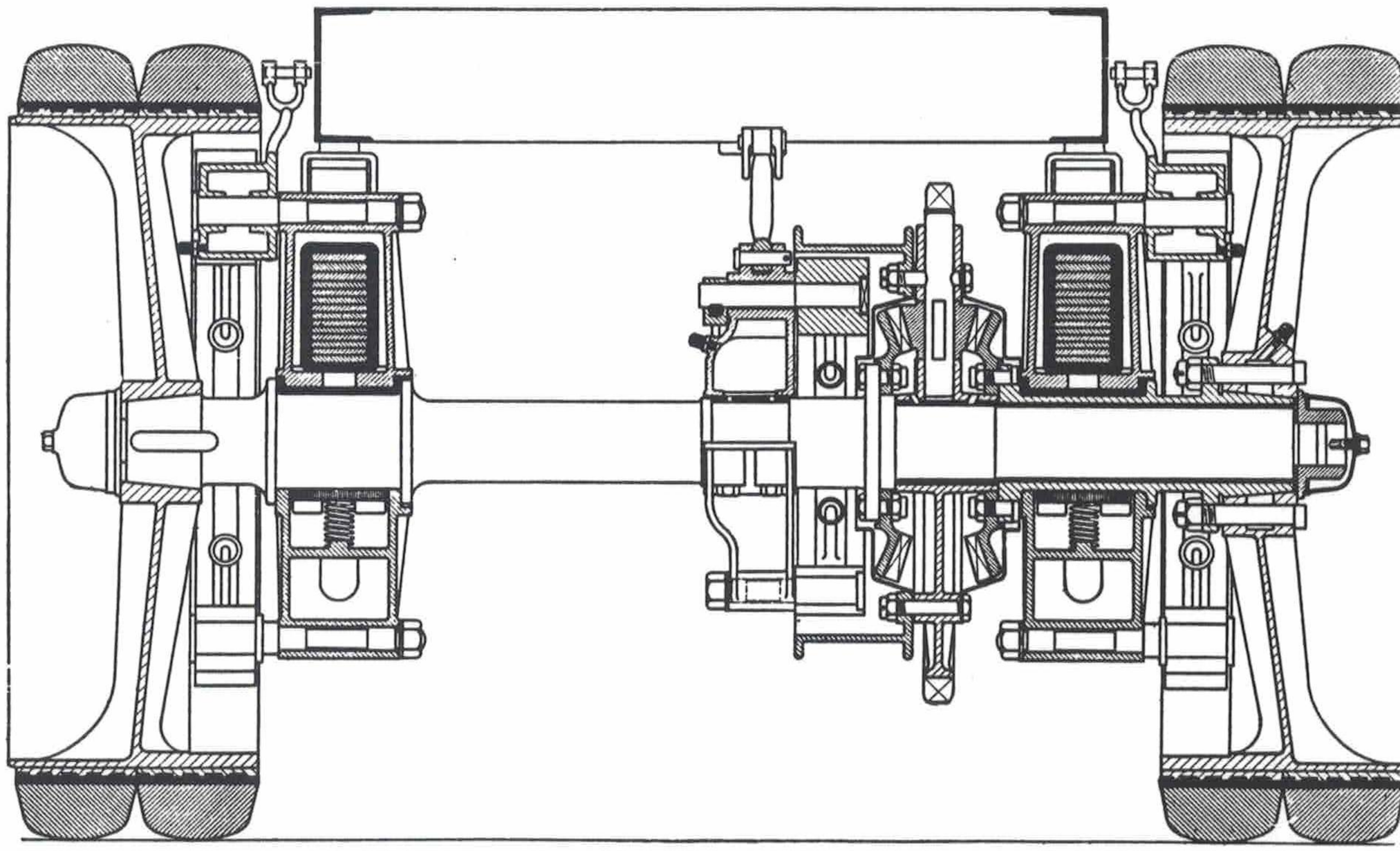


25. Section through the front axle of the Atkinson Uniflow waggon.



27. Atkinson steering gea

26. Section through the rear axle of the Uniflow waggon.



Drawings courtesy Messrs. Atkinson.

Atkinson 'Uniflow' engine, possibly the most successful and powerful steam waggon engine used in the period before the Foden Speed Waggons and the Sentinel S-series. Extremely simple in design, this engine was a duplex, double-acting uniflow type having a bore of 7 in. and a stroke of 10 in. and was based on the experimental work done by Professor J. Stumpf in the United States. One difference between Stumpf's unit and the Atkinson lay in the valve gear; the former was designed for poppet valves whilst the waggon engine used hardened ball valves which proved to be more durable for automotive use especially when used in conjunction with piston relief valves. The engine was fitted to the framing on the nearside by means of cast steel bracket having a reinforcing plate inside the frame to take the five holding bolts, whilst on the offside a cast steel hanger wa clamped on a spherical seating formed on an extension o the crankcase around the main bearing. The upper part o this hanger was bolted to a pair of frame cross-members an to a cast-steel bridge between them. At the front end th crankcase was attached to another cross-member by mean of a yoke bolted at the top by two bolts and fitted into jaw on the crankcase and retained by a fitted pin. This metho of engine suspension allowed the unit to be rigidly mounte on the waggon while the cylinders were free to expand an

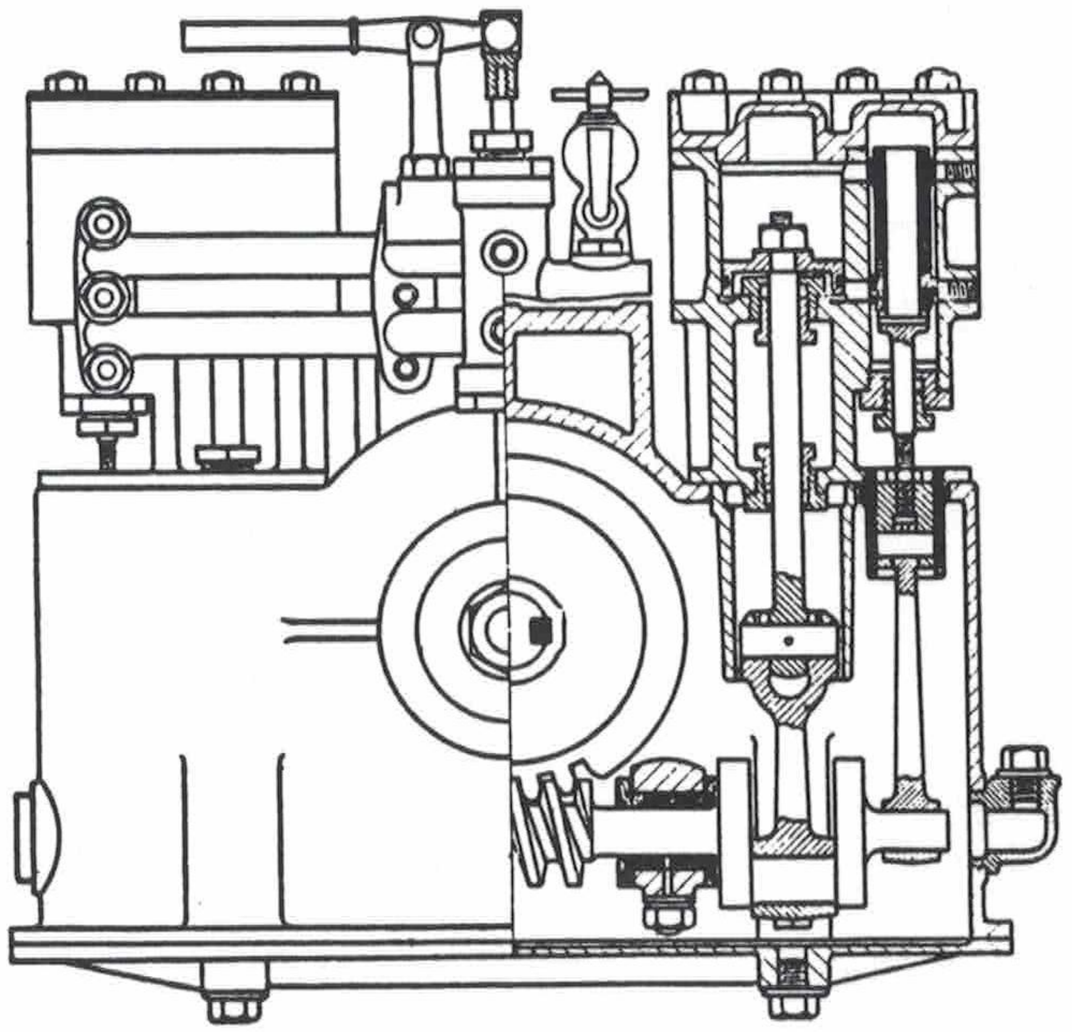
contract without fear of distortion. The cast-iron crankcase itself was cast in unit with the cylindrical crosshead guides and it was fitted with a large cast rectangular panel through which the piston rods and connecting rods could be passed for fitting or removal. The crankshaft was carried in bearings fitted either side of the crankcase; the nearside bearing was housed in a circular cover bolted to the case and carrying the feed-pump and the offside or driving side bearing was fitted in a plain similar cover. The cylinders were retained by a ring of studs, their flanged ends carrying the stuffing boxes.

The crankshaft was drop-forged and machined all over and was manufactured from the best quality Siemens-Martin mild steel. This shaft was supported in the crankcase by two long plain phosphur-bronze bushes and the dimensions of it were as follows:

Crank angle	90° between throws
Journal diameter	3 in.
Journal bearing length	7 $\frac{5}{16}$ in.
Crankpin diameter	3$\frac{1}{4}$ in.
Crankpin length	3$\frac{1}{2}$ in.

The axial location of the crankshaft was held by the outer faces of the crank-webs abutting on flanges machined in the main bearings. Although the driving sprocket overhung considerably it was found in service that wear on the main bearings was negligible both in their bore and on the internal flanged faces.

The valve gear was actuated by a camshaft driven by a train of three gears, the pinion and camwheel being made of mild steel whilst the intermediate wheel was made of bronze to ensure quiet operation. The steam was admitted through special hardened ball valves, fitted at each end of the cylinder, which seated in chrome-nickel seats which were a press fit in the cylinder castings. Each valve was retained on its seat by a helical spring combined with a cup-shaped cover secured by a dog and tooth stud. These valves were opened by long push rods, the tappets having hardened roller cam-followers, the top valve being operated through a short rocking lever with a larger roller bearing on the cam and a smaller one on the tappet. The camshaft itself moved longitudinally and was fitted with five cams to give the four positions of cut-off (25, 50 and 75 per cent forward, 75 per cent reverse) and a fifth circular cam to hold the valve slightly open to allow steam to warm the cylinders through when starting. To ensure the end movement of the camshaft, the driven gear was mounted on a flanged sleeve sliding on its shaft which it drove via a cotter fixed in a boss on the sleeve and retained by a taper pin. The machined channel in the camshaft measured $\frac{5}{8}$ in. × $\frac{3}{8}$ in. × 10 in. long. Any end-thrust occasioned by ordinary running was negligible and when altering cut-off was taken up by the ends of the sleeve-bearing against the crankcase casting. Valve timing was effected by adjusting the gear attached to the sleeve with set screws tightening in slotted holes.



28. Two-cylinder tipping engine designed by Atkinsons.

The steam cylinders were cast separately in best quality close-grained cast-iron, having dished covers retained by studs and nuts. The design of these castings was such that the steam and exhaust ports were very easily cored, whilst the stuffing boxes were integral with the cylinder. In the stuffing boxes, bronze glands and set rings were fitted, and the glands themselves had spherical seatings on loose flanges so that they could not be tilted by careless adjustment. Access to these was gained by removing doors in the crankcase. These cylinders were lagged with asbestos held in position by blued steel cladding.

Special pistons were designed for the uniflow engine because under certain conditions the engine would have refused to run if it had been fitted with normal ones. As a high degree of superheat was maintained in the Atkinson boiler, very little condensation occurred in the cylinder so that when the piston closed the central exhaust ports a certain amount of steam remained behind at a pressure greater than that of the atmosphere; this naturally caused a back pressure and as the engine clearances were small and no flywheel was provided, some other method of relief had to be found. This was done by fitting the piston itself with its own relief valves to enable steam to escape through the exhaust port when the pressure on the steam side of the piston was less than that on the exhaust side. These pistons were bored to take short piston valves, having enlarged heads seating on shoulders at the mouth of the piston with a small radial clearance. The two piston valves at either end of the piston were connected by three bolts allowing them to move about 1/64 in., so that when one end was shut the other was open; within the body of the piston there was an annular space, whilst the centre section of the outside diameter was waisted and drilled to connect with the steam passages inside. There-