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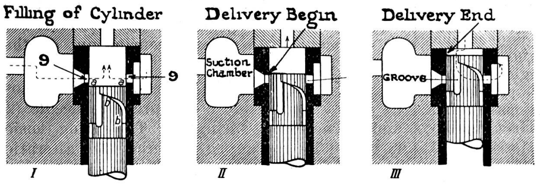

Fig 4
Fuel Injection Pump

Enlarged upper part.

Reference to figure 4 with the piston at its lowest position, shows the suction chamber is connected with the compression chamber through the holes (9) in the cylinder. The stroke of the piston remains the same for all speeds. The top part of the piston is shaped to act as a regulator. The top edge of the piston (a), regulates the pressure or delivery begin, whilst the spiral edge (b) regulates the pressure or delivery end.

A special sleeve (11), carrying a toothed sector, is fitted over each cylinder. This toothed sector engages into the toothed rack (9), figure 3. The special sleeve has two slots at its lower end in which the cross piece (12) on the piston (3) slides up and down. Thus by the movement of the toothed rack or regulating plunger (9), the pistons are turned round on their axis. By this means the spiral edge on the top of the piston is brought earlier or later opposite the holes (9) which are in communication with the suction chamber. This fuel oil pump piston therefore itself regulates the quantities of fuel injected. The action of the pump is as follows:

Figure 4 shows the piston positions for maximum delivery; on the left the piston is at the bottom of its stroke, and on the right at the top (delivery finish). In its lowest position the holes (9) are uncovered by the piston thus allowing the fuel oil to enter the cylinder from the suction chamber. With the upstroke of the piston a small quantity of fuel oil is pressed back into the suction chamber until the top edge (2) of the piston reaches the top edge of the holes (9). From this moment the pressure begins, causing the valve (5) to lift, and deliver the fuel to the injectors. This position therefore, is the pressure or delivery start.

As already stated the delivery end is regulated by the spiral edge of the piston. As soon as this edge passes the hole on the right the cylinder is in communication with the suction chamber and the oil is thus released into the latter. By turning the piston the fuel quantity to be injected can thus be varied as required.

The pressure valve (5) has a hollow body ending in a cylindrical part and is held on its seat by the spring (14). On the upstroke of the piston the valve is lifted from its seat permitting the fuel to pass into the fuel line. During the pump stroke it continues to float under the equal pressure in the pump cylinder and in the fuel line.

When the pump cuts off, (spiral edge comes opposite hole on right) the pressure in the cylinder is instantaneously reduced so that the pressure in the fuel line returns the valve to its seat. By this means the volume in the fuel line is increased by the amount corresponding to the displacement of the cylindrical portion of the pressure valve. This small increase in the volume of the fuel line is sufficient to reduce the pressure in the latter practically to zero, so that the nozzle valve closes immediately, preventing any fuel dripping.

Fuel Filter. Most fuel oils frequently contain an amount of grit and other foreign particles which if allowed to reach the injector pump may cause blockage of the fine oil passages and premature wear of the pump and its working parts. An efficient filter is therefore necessary when filling the fuel tank, but this alone is not sufficient and an additional filter is needed. This is mounted on the engine side of the dashboard, and is easily dismantled for cleaning. The filter is not only capable of segregating grit but also water and air. The importance of separating air bubbles from the fuel will be realised when the precision with which the injector pump and the injectors have to work is taken into consideration.

Owing to the movement of the fuel in the tank, air bubbles will constantly be created. The expulsion of these, before the fuel reaches the injector pump, is essential to the maintenance of regular, smooth, and smokeless running.

Cooling. The cooling of the engine is, in principle, the same as on a petrol engine, *i.e.*, through the radiator, fan, and water pump.

Owing to the greater thermal efficiency of the Heavy Oil Engine less heat is given off from the cylinders to the cooling water. It has been found a great advantage to keep the cooling water at a constant temperature of 70°-80°C. (160°-180°F.). A thermostat therefore is introduced into the cooling system for this purpose.

Controls. The control of the injection quantity is regulated through the plunger (9) figure 3, described in paragraph 9. The movement of this regulating plunger is restricted by a special blocking ring which allows for just the necessary quantity of fuel to be supplied to give full engine output and smokeless exhaust.

The regulating plunger is connected to the governor through links, which are in turn connected to the accelerator pedal and the throttle control lever on top of the steering column. This regulating plunger can be compared with the throttle valve in the carburetter of a petrol engine.

The timing of the injection moment is variable by the small hand lever on top of the steering column. The injection moment can thus instantly be set to suit the particular fuel oil used, and the load under which the engine has to work.

FUEL.

Having extended largely on design and construction of the Heavy Oil Engine, I am sure you will now be greatly interested to know the types of Oils which can be used on these high-speed direct injection engines.

Oils which have been actually tried out were, Gas Oils, various distillates of Crude Oils, Paraffin Base, Naphthalic Base and Aromatic Base. Certain tar oils have also been tried, and oils from coal (low temperature carbonisation), and finally even vegetable oils. All these oils gave, naturally, various results in the running of the engine.

Fuel of the following characteristics will be found most suitable.

Fuel Specification as recommended for Armstrong-Saurer Heavy Oil Engines.

Name: Mineral gas oil.
Use: For Semi Diesel Engines.
Colour: Brown.
Viscosity: Max. 2° Engler by 20° C.
Flash point: Approx. 60° - 70° C. (Pensky-Martins).
Ignition temperature: (With oxygen at 1 atm.) Not to be over 350° C. (In winter it is recommended not to be over 320° C.)
Freezing point: The oil should still be fluid at 5° C. No decomposition should occur.
Calorific value: Upper 10,600 cal. Lower 9,900 cal.
Residue: None.
Specific Gravity: Over 0.84 and under 0.9.
Asphalte contents: None.
Ash contents: None.
Water contents: Max. 1%.
Sulpher contents: Max. 2%.
Distillation: Start at 200° C. when reaching 350° C. 75% of the fuel should be distilled.
Solubility: The fuel should dissolve in normal benzine.

In order to improve the running of the engine with certain oils, tests were made by doping the oils with various dopes, such as Ethyl Nitrate and Amyl Nitrate. Although a considerable range of various oils can be burnt in these heavy oil engines, enormous different devices become necessary to ensure perfect atomisation of these oils, and hundreds of patents are in existence for this purpose; but, it is believed by now that we have come to the limit of achieving complete atomisation by mechanical means, and it will be the chemist who will have to enter the field to find out methods of treatment of oils to make them suitable to run successfully with the existing mechanical devices.

GENERAL ADVANTAGES OF THE HEAVY OIL ENGINE OVER THE PETROL ENGINE.

(1) Forty to fifty per cent. lower consumption—*i.e.*, more miles per gallon.
(2) Low price of the Fuel Oil. 3½d. per Gallon *In Bulk.*
(3) Higher thermal efficiency, thirty to thirty-five per cent., as against twenty to twenty-five per cent. of the petrol engine—thus less waste.
It is also a fact that the heat loss in radiator water on a heavy oil engine, is only thirty to thirty-five per cent., as against heat losses on the petrol engine, of forty-five to fifty-five per cent.
(4) Much less fire and explosion danger.
(5) Owing to the danger of fire of these fuels being much less, storage arrangements can be simpler and, therefore, much cheaper.
(6) The exhaust gasses do not contain any poisonous gases, such as the deadly carbon-monoxide, which occurs with petrol engines and which has been responsible for so many death.
(7) *Better Starting*: It is possible after the first few revs. of the engine to engage the gears and drive away. No necesity of warming up as in the case of a petrol engine.
(8) *Less Maintenance*: It has been definitely established that the maintenance of a heavy oil engine is considerably less, in fact, in the computation of running costs, this is definitely taken as being between ten to twenty per cent. less than that of a petrol engine.

Combining the low fuel consumption and the low price of same, the actual saving in the fuel costs for running a vehicle with a heavy oil engine, as against a petrol engine, is seventy-five to eighty per cent. There is little wonder that the heavy oil engine has been readily adopted by many large firms, keen on having up-to-date transport; and, in fact, the heavy oil engine Chassis turned out from the Saurer Factories number already over 1,350, and there is no other firm in the world who have turned out the number of vehicles with heavy oil engines as SAURER—a proof that this type of engine has definitely come to stay.

There has been often an argument against this great saving in the fuel of these engines, that the price of the fuel oil would rise if the demand for such oils increases, especially since the output of the oil is controlled by the big Oil and Petrol Combines. Against this, it can be said that, if one-third of all the heavy vehicles in Great Britain (this would occupy all the commercial vehicle factories in this country for some years before such a number of vehicles could be put on the road) would be running on heavy oil, it would increase the already existing consumption of heavy oil in this country by only 3.3 per cent., and this could hardly be a justification for increasing the price.

Another way of looking at the matter (as quoted some time ago by another authority) is that, a motor-engined liner, such as the ss. "AUGUSTUS" consumes daily 27,500 gallons of oil; whereas a five-ton heavy oil-engined lorry would run 140 miles per day for over nine years on the same quantity. Although as I have said before, already hundreds of heavy oil engine road vehicles running with as good reliability, and with more economical results as the petrol engine of to-day, which took over thirty years to perfect. The venture of the heavy oil engine is still in its infancy, being the beginning of a new epoch of great historical importance. The heavy oil engine will also before long replace the steam engine, especially the steam locomotive. The new modern heavy oil engine for electric traction is so economical in running, that the steam engine cannot, for this very reason, hold its own much longer. The whole world is out at the present time to economise, and the heavy oil engine is one step towards this end to prevent waste.

It is very gratifying to know that SAURER, as a Swiss firm, has been so instrumental in the development of the high-speed heavy oil engine for road transport, and that the high-power heavy oil engine for rail transport has been brought to a perfection by another Swiss pioneer engineering concern, our Confrères, Messrs. Sulzer Brothers, of Winterthur, so that our little country can definitely claim a big share in this new era of great industrial developments that will rival the introduction of such epoch making machines as the Steam engine, Petrol engines and electric generators, etc.

Inaugural Luncheon given by the Armstrong-Saurer Commercial Vehicles Ltd.

On the occasion of a luncheon given by the Armstrong-Saurer Commercial Vehicles Ltd., at the May Fair Hotel on Thursday, October 29th, an announcement of great importance was made, to the effect that an agreement has been made between the Armstrong Whitworth group of companies and the Société Anonyme Adolph Saurer (Arbon), as a result of which commercial vehicles using heavy oil engines will be manufactured at the Armstrong Whitworth works at Scotswood, Newcastle.

The Chairman, Major-General G. P. Dawnay stated, that no longer were Armstrong Whitworth only makers of armaments. "To-day we are making ploughshares out of swords, and are embarking on a new development for the production of heavy commercial vehicles."

Colonel P. D. Jonides, Chairman of the manufacturing company and Vice-Chairman of the whole of the Armstrong group, said it was hoped that by the launching of a well-tried heavy oil vehicle such as the Armstrong-Saurer, built at Newcastle, work for some thousands of people could be found.

M. Adolph Saurer, the well-known Swiss motor-car engineer and Sir Malcolm Campbell, the world renowned racing motorist, also addressed the luncheon party. Amongst the numerous company was M. M. Golay, Manager of the Swiss Bank Corporation, who is a Director of the Armstrong-Saurer Commercial Vehicles Ltd. The new Armstrong-Saurer commercial chassis are to be seen at the Commercial Transport Motor Show, which opened on Thursday at Olympia. There will be a four-wheel 6 ton chassis, a six-wheeler carrying 12 tons, and a four-wheeler four ton high speed chassis for coaches and fast freight work.