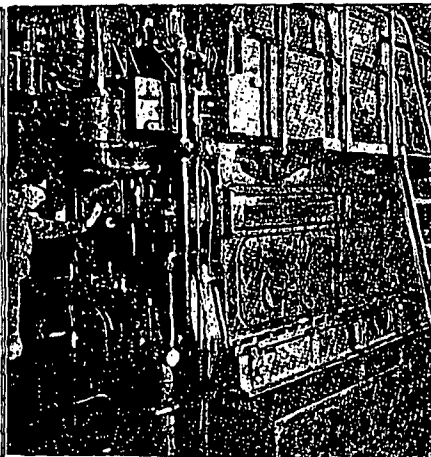
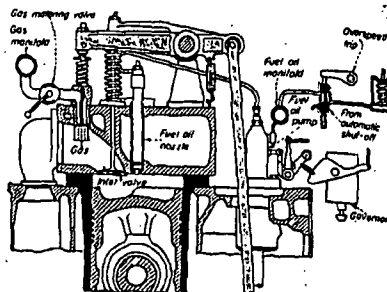




FULL-DIESEL dual-fuel unit, compression spark-ignition gas

DIESELS & GAS ENGINES



THE GAS is drawn into cylinder through inlet valve, while amount of gas is controlled by metering valve in this engine

Dual-Fuel Maintenance

By C MORGAN JONES, Diesel Engineer

► BOTH GAS-ENGINE and diesel men often regard the dual-fuel engine as something of a mystery. But, while different, it actually calls for no specialized maintenance know-how or operating ability. There are some equipment parts on a dual-fuel engine not found on the full diesel, though. These are commonplace on the full gas engine.

Scrubber. First of these extras is the gas scrubber, between the gas main, supplying the plant and the engine. If gas is corrosive, scrubbers remove troublemakers, which greatly extends liner, piston and valve life. Fit two scrubbers so you can clean one while the other takes load. If only one is used, operate engine as a full diesel while changing or cleaning scrubber.

Reducers. Next are the gas pressure-reducers. You must always use these even when gas pressure is low, as they maintain the right pressure. When gas pressure is high, I've found that two

reducers give better gas-pressure control. Reduced gas passes to receiver.

Receiver pressure is important and receiver's capacity depends on engine size. A good receiver capacity-formula is to allow 0.02 cu ft of capacity for each 1000 Btu contained in a cubic foot of gas. Multiply answer by engine's full-load horsepower. If gas value is only 500 Btu, receiver capacity must be doubled. So if engine is rated 1000 hp and gas value is only 500 Btu, receiver capacity will be 40 cu ft.

From receiver, gas passes to engine's gas manifold. Manifold pressure is important. For supercharged engines, a manifold pressure of 10 to 20 psi is best, but exact pressure depends on engine itself. Rarely will two engines burning the same fuel give identical performances under similar conditions. Instead, I find that trial and error often decide best operating pressure.

For nonsupercharged engines, gas

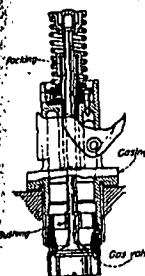
pressure can be anywhere between three and seven inches of water. But, again, heat operating figure depends on engine and gas quality.

Gas hookups for units, both small (about 150 hp) and large (to 3000 hp and more), are shown in sketch (right, facing page).

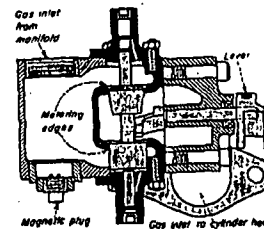
Metering Valve. Gas next passes to the metering valve. This valve (sketch, center on facing page) is operated through a fuel-gas control shaft, operated in turn by governor linkage. These valves are important. They can be individually adjusted for required gas flow to each cylinder.

When engine is running, compare exhaust temperatures. If there's a difference of more than 50 F at full load, adjust metering valves until exhaust temperatures are balanced and within 50 F of each other. It's usually best to reduce high temperatures instead of bringing all readings up to high figure. Reduce unless they are well below maximum figure recommended for engine when running at full load. If below, admit more gas to low reading cylinder to increase exhaust temperatures.

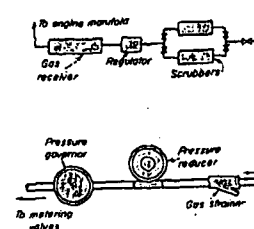
Pay careful attention to timing of gas-injection valve. This valve admits metered gas into engine's air intake manifold. Sketch above shows position. Don't open gas injection-valve while exhaust valve is open. In all modern engines, exhaust, air-inlet valves are both open briefly as piston passes through top center, at end of exhaust, and beginning of air-inlet stroke. Injection valve opens the instant exhaust valve closes. If gas injection-valve opens



Gas injection valve must work freely. Make sure bushing does not bind stem



Gas metering valve of dual-fuel unit is actuated by the lever at the right



GAS-MAIN hookup for large engine is at top, for small engine at bottom

Gases Burned in Dual-Fuel Engines and Their Values

Gas	High heat value Btu per cu ft	Cu ft air needed to burn 1 cu ft	Btu value per cu ft of mixture
Carbonated water gas	570	4.65	98.6
Coal gas	534	5.90	97.7
Calorifier gas	536	4.65	94.5
Natural gas	1125	10.84	94.8
Blue-water gas	310	2.78	94.5
Oil gas	516	4.25	93.3
Sewage gas	652	6.21	90.5
Produce gas	156	1.88	63.3
Black-ferrous gas	95	0.70	54.7

before exhaust valve is closed, gas will pass across combustion space and out of engine into exhaust manifold, where it may burn in exhaust lines or silencer. Injection valves are often operated by their own individual camshaft, or by an additional cam, on main camshaft. If camshaft is correctly timed, then valves must also be correctly timed, so only adjustment needed is at valve tappets. Sketch (left, above) shows one type of gas injection-valve.

One make of dual-fuel engine operates on high-pressure gas. Gas enters compressor from scrubbers and is delivered to cylinder-head valve at about 100 psi. Compressor is engine mounted and independently powered. Gas is held in receiver for delivery to engine.

Valves run hotter on most dual-fuel engines than on full diesels. Often, you may have to make slight tappet adjustment besides those manufacturer recommends for best operating results. If one cylinder continually detonates, retard its fuel-oil pump timing from one to three degrees. This should help unless its cause is something unusual, such as increased compression ratio for that cylinder.

Always carry cooling-water temperatures as high as manufacturer allows. When engine runs on full oil and gas mixture (with plenty of gas) but gradually moves into oil operating range so percentage of oil burned slowly increases, check gas pressure at main and receiver. Trouble may be dirty gas, or burner or cleaner, or defective gas regulators. Governor linkage needs accurate ad-

justment. Always check gas metering-valve and fuel-injection pump linkages. Make sure distances between linkage-pin centers are correct at every overhaul. These dimensions can affect metering of oil fuel and gas. If engine "hunts" (speed varies at constant throttle setting) inspect linkage for binding and, if a long time has elapsed since last overhaul, for wear.

Trouble shooting in dual-fuel engines. Let's say engine is running on oil, and control lever or wheel is turned to the gas position. If engine loses speed, line valves in gas hookup may be closed or only partly opened.

If engine fails to pick up speed when running on gas-and-diesel fuel mixture, check the gas metering-valves. They may be improperly set. Faulty setting of valve can also lead to "hunting."

If engine knocks when running on diesel fuel, and gas injection of "pilot" fuel is taking place too early, retard

injection. Clearance of gas injection-valves may be too little, or injection valve may be leaking. Often valve packing is too tight and needs slackening back to allow valve to move freely and admit full quantity of gas to cylinder. Knocking can also be from unbalanced cylinders.

If engine starts but runs erratically when placed on gas fuel, check for: (1) low gas-fuel pressure (2) defective gas regulators (3) incorrectly adjusted gas throttle (4) incorrect gas-injection-valve clearance.

Should engine misfire in exhaust manifold, pilot fuel-injection is taking place too late.

If pyrometer readings show temperatures are too high in all cylinders, check for late injection of pilot oil.

If temperature is high in one cylinder only, trouble is often due to injection valve sticking because valve-stem packing is too tight. Check stem for grooves.