Care and Operation of Multi - Cylinder Engines

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INTERNAL COMBUSTION ENGINES

All internal combustion engines are built to give long, trouble free service. An internal combustion engine, in order to operate, must have fuel, air, oil and a coolant (usually water).

The condition of these four items determines the useful life of an engine. Let's discuss each of these and attempt to point out desirable standards and how to combat below standard factors.

Since the majority of engines used are gas engines, we will talk about natural gas as a fuel. Most gas used is a field gas and engine users don't have much choice but to use it as it exists. In discussing fuel, we must also consider its effect on lubricating oil.

Natural Gas

Natural gas, containing sulphur, has undesirable effects when used as an engine fuel, the principal hazard being acid formed by the products of combustion. Since all engines leak a percentage of combustion gases past the rings into the crankcase, this contaminates the lubricating oil. Sulphuric acid contained in these gases causes sludge to form. This condition keeps lubricating oil from freely reaching the bearing surfaces, resulting in premature failure and costly down time. This particularly is true where splash lubrication is employed. Where ambient temperature tends to fluctuate and cold winds blow on engines, condensation creates a surprising amount of water in the crankcase.

One of the best means to eliminate these gases and liquids from the crankcase is to operate the engine at a high enough temperature to dissipate them in the form of vapor. Fuels of all types should contain less than 3 grs. per cubic foot of sulphur and should be practically free of solids and abrasive materials. Natural gas should be free of crude oils and other liquids.

Since all fuels are not free of solids and there is generally some pipe corrosion present, scrubbers, volume tanks and fuel filters will save many times their cost in prolonged engine life. These scrubbers, wolume tanks and filter cases should have drain provisions for elimination of accumulated liquids.

Natural gas is piped to engines from various sources and pressures. Naturally, regulators must be used to handle the fuel so that it is reduced to a final ample volume (from 4 - 6 oz.) to the engine. If gas is furnished to a natural gas engine with the above care, engines should perform many thousands of hours with little or no trouble from fuel.

The above requirements can easily be met except when there is sulphur content: again, this will not materially damage an engine if operating temperature is 180°-190°, except where sulphur content exceeds 3 grs. per cu. ft.

Natural gas as a fuel has an octane rating of 118-120. To take advantage of this, for power, you should advance the spark on the flywheel to the factory recommendations. Propane has an octane rating of 95-96 and the spark advance would naturally be reduced. This can also be set to the manufacturer's settings.

LUBRICATION

Modern lubricating oils do many jobs in modern oil field engines. Beside lubricating the moving parts, the lubricating oil also serves as a cooling medium, absorbing heat from the bearings and gear trains and, in turn, being cooled by oil cooler, the air circulating in crankcase and crankcase reserve. In this case, the crankcase capacity contributes to the final operating temperature of the oil.

Many crankcases have a fine spray of oil coming from the connecting rods, main bearings, cam bearings, and other pressure feed points of the engine. This fine spray contributes to the mixing of combustion gases and the oil. Combustion gases consist of water vapor, carbon monoxide, carbon dioxide and other compounds of sulphur.

When these compounds mix into the lubricating oil with carbon particles, fine metal particles (resulting from wear) and dust from atmosphere, the oil begins to sludge. Sludge is usually acid in nature and attacks vulnerable parts of the crankcase such as rod and main bearings, aluminum pistons, etc. This acid also pits cam lobes and cam followers and has its effect upon gear trains and many other items of the engine, resulting in unusually high wear. Sludge in the crankcase will restrict the oil pump screen in various degrees, effecting oil pressure further, reducing lubrication and contributing to premature failure of engine.

Detergents, Inhibiters And Other Agents

Major oil companies have solved a large percentage of problems by adding detergents, inhibiters and other agents for various purposes.

We all know the main effects of detergent oils. Since one of its functions is to hold the materials in suspension, which causes sludge, it is more important than ever to service oil filters regularly in order to take full advantage of the H.D. oil. Heavy duty oils are inhibited against their becoming acid as readily as noninhibited oils and therefore should be used where fuels have a higher than normal sulphur content.

All engine manufacturers are asked by their customers for a recommended oil change interval. They cannot do this because of the many conditions engines

are subjected to, such as quality of fuel, atmospheric conditions, dust, load condition of engine, etc. For these areasons any recommendation made would be minimum rather than actual life of oil; therefore, the only answer possible is - change oil when necessary.

This can only be determined by a laboratory analysis after samples have been drained from the crankcase at regular intervals and tested. An oil filter on the engine can increase oil life and engine life only if it is serviced regularly. Again, like oil, no specific interval can be set. It must be serviced when necessary. This can be determined by regular inspection.

Most engines have crankcase breathers, usually on the oil filter neck and the valve cover assembly. These should be washed in a petroleum solvent at the same time the oil filter is serviced. Crankcase breathers must be kept clean in order to allow products of combustion to vent out in the form of vapor.

COOLING

The condition of water used in internal combustion engines is another very important item contributing to long engine life. Not only must the cooling be kept in adequate supply but the cooling system must be protected against corrosion and scale deposits. Scale deposits begin to form several degrees below the usual operating temperature of the engine. The higher the temperature, the more the scale deposits increase within the cooling system. Naturally, therefore, the scale will deposit first on the higher temperature parts of the engines, such as the upper cylinders, and in the head around the exhaust seats and exhaust outlets. This condition will create an uneven cooling from one portion of the engine to the other, causing the parts to distort or warp out of their original shape.

As the engine increases in operating hours the scale also increases. This is a slow process which allows the rings to wear the cylinder walls to a degree of distortion. After the scale deposit reaches a certain point, engine overheating is experienced. When this condition exists, then the only thing that can be done is to partially disassemble the engine and acidize the cooling system to remove the scale.

The acid removes a good portion of the scale immediately, but in a good many cases after the engine has been reassembled scale deposits, affected by the acid, become loose in the form of various size sections. There is a danger of these being washed into the upper tank of the radiator, stopping circulation through the tubes, and again we face the danger of the engine overheating; again, all precautions must be used and observed in treating a condition of this kind. We mentioned the results of scale within the cooling system in order to clarify our problem. Scale deposited to the thickness of 1/8 inch is equivalent to 1 inch in cast iron in insulation value.

Two Problems

When an engine is experiencing overheating troubles, not only is this endangering the upper portion of the engine but high engine operating temperatures often result. In this case, higher oil temperature rises to the point of damaging bearings without the coolant temperatures reaching the boiling point in the cooling system. This type of damage is not done suddenly but within a period of weeks or even months. Therefore, we actually have two separate and totally different problems in treating cooling jacket water. One deals with the elimination of scale deposits and the other deals with the elimination of corrosion.

There are many water conditioners available to minimize both problems encountered in cooling systems; therefore, most engine manufacturers constantly urge their customers to treat the coolant in the cooling systems of their engines with all of the "know how" at their command. Most oil field engines would have more than twice the life they normally do if corrosion and scale were not present. An engine should never be operated when the temperature goes above normal. When an engine begins to overheat, many times the operator removes the thermostat, thinking this will help to cool the engine.

Thermostats should never be removed nor should the engine be operated without them. The thermostat is not only a means of controlling the coolant temperature and lubricating oil temperature: it serves another important function by creating a restriction to the flow of water through the engine in such way that the engine can be maintained at the proper temperature at all times. There seem to be many conflicts about the proper operating temperature of an engine. All engines, for good efficiency, must operate at not less than 170° temperature.

All engines are designed so that the water temperature differential from the outlet side to the return portion of the engine should not be much more than 12°.

Engine manufacturers are constantly raising the operating temperatures of engines as fast as reasonable means can be found to retain the coolant at higher operating temperatures. We know this tends to get greater fuel efficiencies, longer lubricating oil life and longer engine life.

AIR & AIR CLEANERS

All engines are equipped with air cleaners; clean air is of the utmost importance to the life of an engine. Even with the best air cleaners obtainable we get too many solids into the engine. There are two types of air cleaners. The first and most popular is the oil bath type which is more than 95% efficient when operating under proper efficiency. There are a number of dry type air cleaners in which the efficiency leaves a lot to be desired. For example, should there be one grain of sand in every cubic foot of air an engine would not last a month; therefore, you can readily see why we are not too high in our praise for the available air cleaners being used on engines. Also, should there be no oil in your oil bath cleaner, the life of your engine would be reduced as much as 90%.

Therefore, we again must urge the users and operators of engines to properly service air cleaners in order to protect the engine. Most air cleaners are mounted somewhere outside the sheet metal housing of an engine with various types of air ducts going from air cleaner to carburetor. These should be checked periodically to be sure there are no leaks allowing raw air to get into the fuel system.

I have not gone into the ignition system in any detail and do not intend to do so. I think it is timely, however, to remind you that spark plug gap settings do reflect magneto life, and that excessive clearances will put a strain on the secondary coil or high tension

coil and can cause this to break through. As an illustration, spark plugs in an ordinary passenger car gap open on single points. Plugs wear .001 for every 1,000 miles of running. Interpolating this into hours, you can readily see that they must be checked regularly for proper spacing; therefore, with proper attention to spark plugs, you will get longer trouble free ignition service.

CONCLUSION

Now we have talked about the basic elements that will motivate an engine so that it can produce working H.P. for its owner. In all cases the precautions we have discussed lead to longer engine life which is the never-ending goal for all engine operators.

A few of the engine manufacturers are beginning to make, and offer for sale, engines with additional accessories which will automatically help the engine to operate longer without personal attention. This is being done by having as standard equipment low tension magneto ignition systems, crankcase ventilation systems, special spark plugs, water filters, oil level oil regulator controls and exhaust condensers which automatically take care of any make up water required in the cooling system.