From Diesel Engines Evaluation of Field Methods Of Increasing Horsepower

Henry L. Kucera and Gary P. Artz

The size of tractors used on farms is increasing. Nebraska tractor test reports show the average increase in tractor size is 2.3 horsepower per year. A tractor suitable in 1964 may be 10 horsepower too small today. A farmer desiring more horsepower from his tractor has two alternatives: (1) Trading for a larger tractor, or (2) modifying his present tractor. Field methods used to increase the horsepower of diesel tractors include overspeeding, oversizing, overfueling, LP (Liquified Petroleum) gas injection and turbocharging. All of these modifications will produce a power increase, but problems may develop with usage.

INVESTIGATIONS

Tests were conducted to compare LP gas injection, turbocharging, and overfueling.

LP Gas Injection:* (Figure 1)

LP gas is fed into the intake manifold of the diesel engine. The LP gas and air mixture is ignited by the injection and burning of the diesel fuel. The LP gas utilizes the excess air normally available in a diesel engine. LP gas is fed to the engine under heavy loads when more power is needed. The unit complete with a tank is adaptable to most diesel tractors. It costs about $150.

Turbocharging (Figure 2)

A turbocharger utilizes exhaust gas energy to drive a turbine which pumps air into the intake manifold of the engine. Additional fuel may be injected to burn the air supplied by the turbocharger. Turbochargers are available for many tractor models for approximately $500.

Overfueling

Overfueling consists of injecting a higher than normal quantity of fuel into the engine. Some of the excess fuel burns with the normally excess air, but inefficient combustion and excess smoke may be produced by overfueling. Overfueling or overspeeding may require internal adjustment of the diesel fuel pump. This cost varies widely.

An 84 horsepower farm diesel engine was used for these tests. Tests similar to those performed in the Nebraska Tractor Tests, plus lugging tests from rated speed and reduced speed, were conducted. Horsepower, fuel consumption, exhaust smoke, temperatures, air consumption and lugging ability were measured.

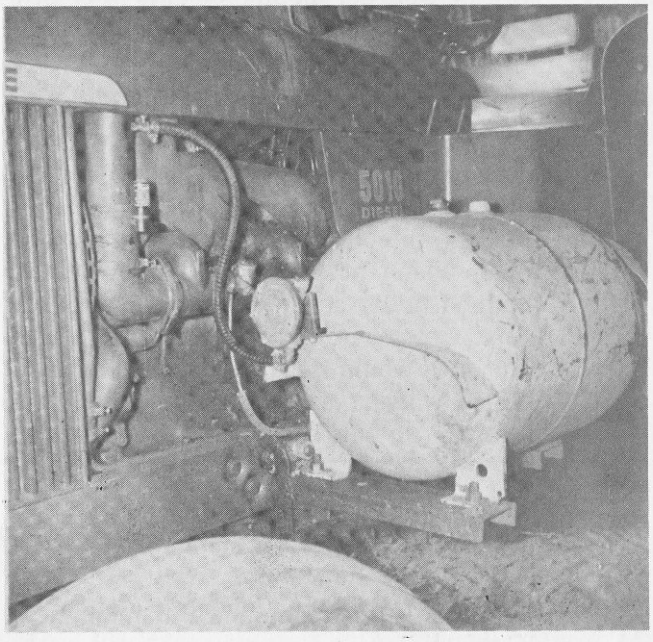

Figure 1. LP Gas Injection Unit on a Diesel Tractor.

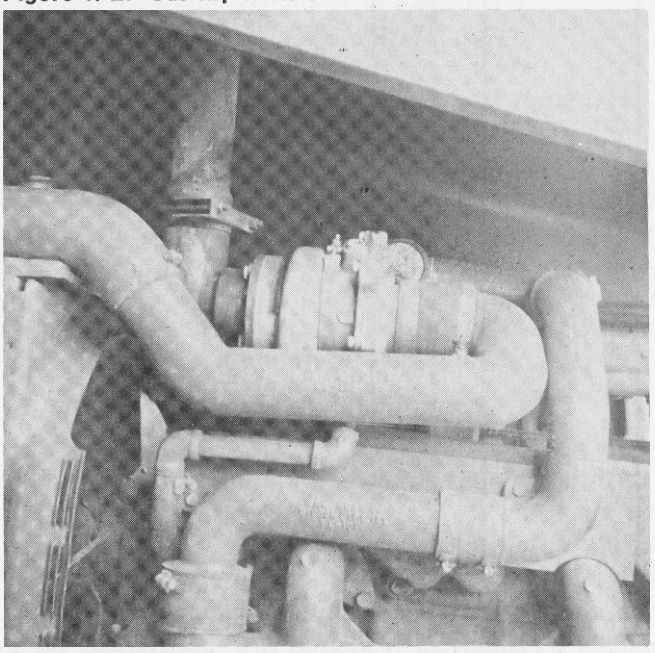

Figure 2. Turbocharger Unit on a Diesel Tractor.

Kucera is associate professor and Artz former graduate research assistant, Department of Agricultural Engineering.

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The North Dakota State School of Science, Wahpeton, North Dakota

Northern Propane Gas Company, Moorhead Minnesota

Borg Warner Corporation, Decatur, Illinois.

**Commercial device used for LP gas injection was the "Torque Topper" manufactured by Borg Warner Corporation, Decatur, Illinois.*

CONCLUSIONS

1. Horsepower (HP) — The turbocharger plus additional diesel fuel raised the power output of the 84 HP engine to 122 HP. The maximum power with LP gas injection was 102.5 HP. Overfueled tests were limited to 88 HP because of high exhaust gas temperatures and smoke levels. Without extra fuel, the turbocharger equipped engine produced 2.5 HP over the regular 84 HP output.
2. Most power per pound of fuel was produced by the turbocharger equipped engine. LP gas injection did not lower the overall fuel consumption compared with stock conditions.
3. The lowest exhaust gas smoke levels were recorded during the turbocharger tests. LP gas injection caused higher smoke levels which at times were above those attained under stock conditions. LP gas is more expensive per pound than diesel fuel, so it would not be economically feasible to convert a stock diesel to LP gas injection on the basis of fuel cost alone.
4. Overfueling caused the highest exhaust gas temperatures. The turbocharger tests produced the lowest exhaust gas temperatures. The large volume of air supplied by the turbocharger appears to be responsible for the lower temperatures (See Figure 3). The exhaust gas temperature with the turbocharger at 122 HP was 1170°F. This was lower than the stock temperatures at 84 HP (1210°F) LP gas injection did not significantly lower the exhaust temperatures compared with stock or overfueled tests.
5. LP gas injection produced high torque increases (good lugging ability) in lugging tests at 84 HP and rated speed. This increase was not noted during the other tests with LP gas.

It is concluded from these results that the turbocharger is the superior method for increasing diesel engine horsepower. LP gas injection has merit as a means of increasing horsepower, while overfueling is not recommended.

It is well to note that modification of an engine may void the manufacturer's warranty and decrease the engine's life. Also, increased horsepower will shorten drive train component life.

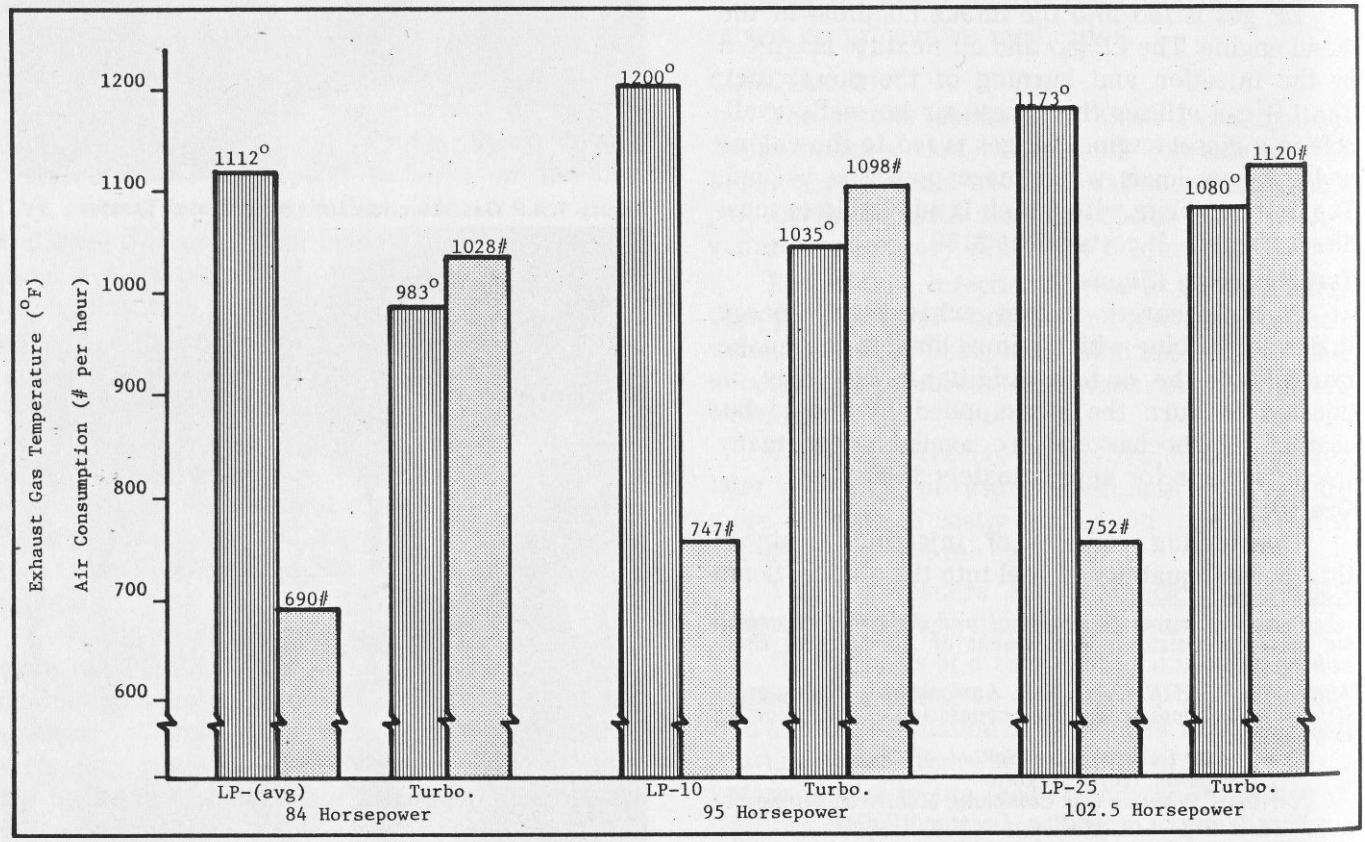

Figure 3. Comparison of Exhaust Gas Temperatures and Air Consumption for LP gas injection and turbocharging at various Horsepower settings.