A SELF-CLEANING PRE-CLEANER WITH ASPIRATOR FOR FARM POWER UNITS

By Charles L. Peterson and Larry G. Williams*

An air cleaner is essential for proper operation and long life of a modern farm engine. For many years, oil-bath air cleaners were standard installations on farm tractors. Now, nearly all new tractors are equipped with a dry-type air cleaner because they do a more efficient cleaning job throughout the servicing period.

Both type of air cleaners are efficient, but servicing can be costly. A pre-cleaner is necessary to extend the service interval under most operating conditions.

PRE-CLEANERS

A pre-cleaner is a cleaning device added ahead of the air cleaner to remove part of the dirt before it can enter the main cleaner. The pre-cleaner will not improve efficiency of the unit but it will prolong the servicing period. This is especially important with a dry-type air cleaner. Servicing these units is a time-consuming job and replacement cleaning elements are relatively expensive.

Several types of pre-cleaners are in use. Most remove the larger dirt particles by means of a screen or filter cloth, or through a centrifugal principle. A centrifugal pre-cleaner is built into many dry-type air cleaners today (Figure 1). Air entering the housing is passed through vanes which give it a whirling action. The larger particles of dirt are thrown to the outside of the housing and collected in a discharge chamber. Most of these pre-cleaners and the screen or filter type require regular servicing.

Recently, a self-cleaning pre-cleaner (Figure 2) has been introduced which combines the centrifugal principle with an aspirator or venturi on the engine's exhaust.

This pre-cleaner has stationary vanes which rotate the air as it enters the cleaner (Figure 3). Centrifugal force then carries the larger dirt particles to the outside of the housing. A cross-tube connects the housing and the exhaust. A venturi on the exhaust creates low pressure in the cross-

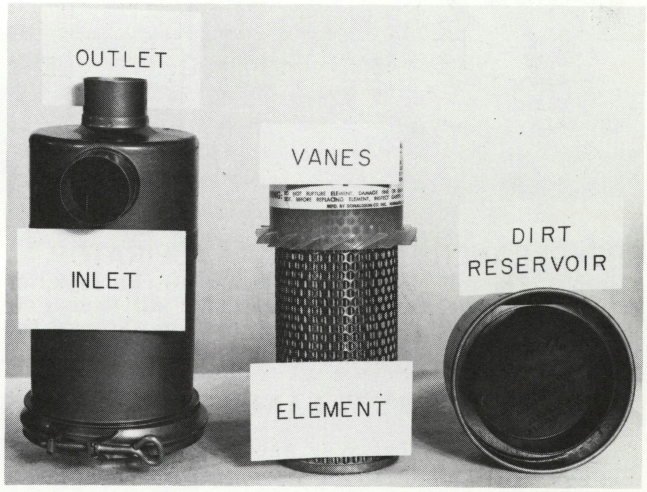

Figure 1. A typical dry-type air cleaner with a built-in pre-cleaner.

tube, which builds up an air velocity in the tube of about 1,000 feet per minute. This is enough to carry the dirt away through the exhaust.

Since this pre-cleaner discharges dirt as quickly as it is removed from the air, the unit doesn't build up dirt to increase restriction of air flow. Southern Idaho farmers who have used the new pre-cleaners are generally pleased. They report that oil in the oil-bath air cleaners stays clean longer and the dry elements require less frequent servicing and replacement. They have observed no adverse affects on engine performance.

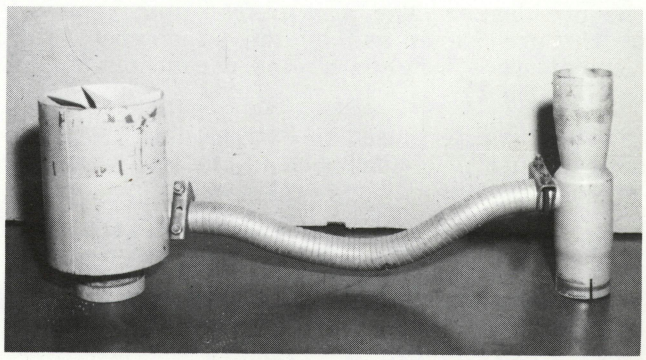

Figure 2. A self-cleaning pre-cleaner with aspirator.

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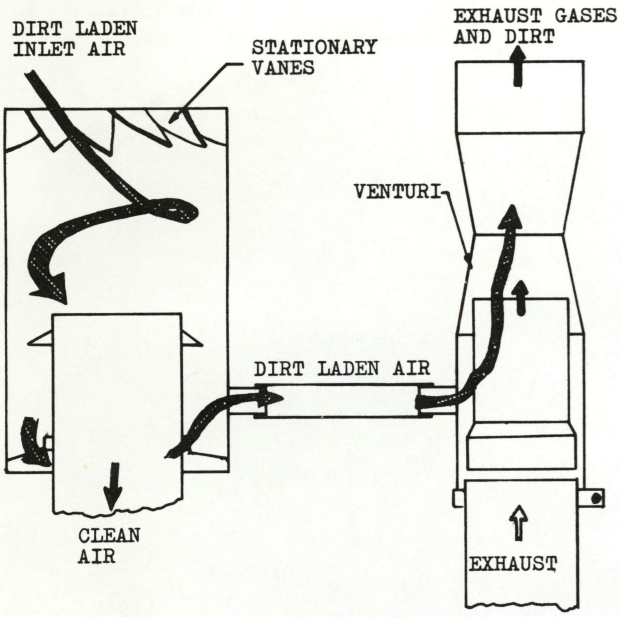

Figure 3. The self-cleaning pre-cleaner uses an aspirator on the exhaust to draw the dirt-laden air through the cross-tube and out through the exhaust tube.

LABORATORY PRE-CLEANER TEST

A laboratory test was set up in the Department of Agricultural Engineering to compare the cleaning efficiency and operation of the new pre-cleaner with aspirator and a standard design tractor pre-cleaner. Both pre-cleaners tested were designed for use with 90 to 100 horsepower diesel engines. Laboratory tests can only approximate actual field conditions, but the results can serve as a guide in estimating a pre-cleaner's value.

Air for the tests was provided by two blowers: one to simulate the air intake to the engine, the other to simulate the exhaust. Airflow rates were adjusted to those actually occurring in a tractor of this size under load.

A "standard dust" for air-cleaner testing, coarse grain and specially size-graded, was used in the test. One hundred grams were weighed and put into the air stream which passed through the pre-cleaner. The amounts of dust removed by the pre-cleaner and by the air cleaner filter element were weighed at the conclusion of the test (Table 1).

The air filters used to extract dust from the air stream at the conclusion of the test were not 100 percent efficient so a small amount of dust could not be accounted for. Additional tests indicated that this loss was distributed between the pre-cleaner and air cleaner in proportion to the percentage of dust retained by each unit.

Table 1. Laboratory comparison of two types of air pre-cleaners, University of Idaho Department of Agricultural Engineering

Grams of dust removed by:	Pre-cleaner with aspirator	Standard built-in pre-cleaner
Pre-cleaner	85.1	60.0
Air filter	9.7	37.9
Unaccounted for	5.2	2.0
%dust removed by pre-cleaner	89	61

Which Air Cleaner— Dry-type or Oil-bath?

The farm equipment industry now installs the dry-type air cleaner as standard equipment on farm tractors. The reason is superior performance.

An oil-bath air cleaner maintains high efficiency only at its designed air-flow rate. Efficiency decreases as it accumulates dirt. Changes in oil level in the reservoir and changes in oil viscosity caused by changes in temperature also affect its cleaning performance.

This is not true for the dry-type cleaner. This unit maintains high efficiency throughout the servicing interval. Servicing is required when the dirty element restricts air flow enough to affect engine power.

The standard pre-cleaner removed 61 percent of the dust from the air stream. The pre-cleaner with aspirator removed 89 percent. In other words, the standard pre-cleaner allowed about 40 grams of dust to reach the main air cleaner; the pre-cleaner with aspirator allowed only 10 grams to pass. This would indicate an increased useful filter life—possibly by four times—through use of the new pre-cleaner.

Particle sizes were not analyzed to determine if either pre-cleaner tended to break up the dust particles. A smaller particle size would possibly lower the efficiency of any air filter element.

CONCLUSIONS

On the basis of these laboratory tests using a standard test dust and air-flow rates similar to those with a 90 to 100 horsepower diesel engine, the pre-cleaner with aspirator unit efficiently removed dust from the air stream. Under extreme dust conditions, this unit would increase the service life of dry-type air cleaners or the service interval of oilbath cleaners.

The pre-cleaner with aspirator should never be used as the only air cleaning device on an engine. The amount of dust which passes through the pre-cleaner is enough to damage an engine in a short time even under normal service conditions.

Caution: The engine manufacturer should be consulted before recommended filter replacement intervals are altered. Such changes may void the warranty.

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