SMALL ENGINES MAINTENANCE

Robert G. White, Professor
Department of Agricultural Engineering
Michigan State University

Small engines have almost become a "way of life" for all lawn and turfgrass maintenance. They save time, they reduce the physical labor required of employees, and they enable a small labor force to maintain a large lawn and turf area. They will mow the lawn, they will sweep up the leaves, they will power lawn aerators, they will dig holes for transplanting trees and shrubs, and a thousand and one other chores. But at the same time, they are temperamental and can cause all sorts of annoyances.

But many of these annoyances are a direct result of improper care and maintenance. In the next few minutes I would like to direct my comments to two or three maintenance items which I feel are at least indirectly responsible for many of the problems encountered.

But first, let us take a look at some of the classifications of small engines, because these are sometimes a key to many of our problems. Basically, small engines fall into two specific design classifications:

1. Four stroke cycle engines
2. Two stroke cycle engines

With the four stroke cycle engine it takes two complete revolutions of the crankshaft to complete one full cycle. The four strokes of the power cycle are: (1) intake, (2) compression, (3) power, and (4) exhaust. All of these operations take place in the combustion chamber, above the piston head. With a two stroke cycle engine, however, it only takes one revolution of the crankshaft to complete a power cycle. This is accomplished by utilizing the crankcase area below the piston as well as the combustion chamber above the piston to fulfil all the requirements of the complete power cycle. With this engine, the fuel mixture is drawn into the crankcase when the piston is on the upward stroke and is bypassed around the piston to the combustion chamber as the piston makes its downward stroke. With this type of operation it is obvious that oil for lubrication cannot be contained in the crankcase of the conventional two cycle engine. Therefore, it is necessary to mix the oil and fuel together, and all lubrication takes place as the result of the oil being carried into the engine with the fuel.

With this background let's now take a look at two or three of the problems commonly encountered with all small engines.

First, fuel selection, handling, and storage is always a problem. Fresh, gum-free fuel is necessary to keep from gumming up the carburetor, valve stems and integral portions of the combustion chamber. Clean fuel is necessary to keep from plugging up the carburetor. Generally speaking, a good quality, regular grade gasoline is adequate for both two stroke and four stroke cycle engines. Very few small engines require a premium grade fuel. Check your operator's manual for each specific engine, and provide a fresh supply of the proper quality fuel for each engine.

Fuel stored for excessively long periods, particularly in tanks subjected to direct rays of the sun, tends to gum up, form varnish, and lose the more volatile (easy starting) portions of the fuel. If fuel cannot be stored in underground tanks, at least store it in a shaded area.

The second problem I want to discuss is spark plugs. Spark plugs are the much maligned culprits for many small engine difficulties. Keep in mind that spark plugs must have the correct "reach", the correct "heat-range", and the correct "gap" at the electrodes for good engine performance. The "reach" of a spark plug is the distance from the shoulder where the plug seals against the cylinder head to the spark gap where the spark occurs. This places the spark in the correct position within the combustion chamber so that the engine can start readily and develop full power. Check your operator's manual to be sure you are using spark plugs with the proper "reach". The heat range of the spark plug determines the temperature at which the end of the center procelain operates when the engine is thoroughly warmed up and operating under load. The heat range is determined by the length of travel required of the heat generated when the spark ignites the fuel, before it is dissipated through the spark plug shell and into the air. A spark plug that is too "cold" tends to dissipate heat too fast and fouls out quickly. A spark plug that has too "hot" a heat range tends to burn itself out quickly and may even run hot enough to cause pre-ignition of the fuel before the spark actually occurs. Again, check your operator's manual for the correct heat range of plug for each engine. There is, however, a rather easy way to determine the proper heat range. A used plug that is rather black and sooty in color is almost invariably too cold for the type of performance desired. A spark plug where the porcelain is white, ashy, and parts of the porcelain starting to chip away, is entirely too hot for the type of service expected of it. A used spark plug of the proper heat range will have a fairly light chocolate brown color to the center porcelain, or be about the color of coffee with a little cream added to it.

But also keep in mind that the plugs which operate satisfactorily in a four stroke cycle engine are not satisfactory for service in a two cycle engine. Since two cycle plugs are required to burn a mixture of fuel and oil, it is evident that the combustion conditions inside the combustion chamber are extremely "dirty" in nature. Special two cycle plugs have been developed which have a resistor in the center electrode, more clearance between the center porcelain and the shell, and a resistance to fouling. These plugs also have a short ground electrode which makes it more difficult for flying carbon particles to wedge between the ground and center electrode. See Figures 1 and 2 for the ground electrode of a conventional plug and that of a special two cycle plug.

The third thing which I wish to talk about this morning, and probably the one which causes the most problems, is the selection of oil. With a four stroke cycle engine, use any good quality motor oil in the crankcase, but be sure to change the oil at intervals as recommended by the engine manufacturer. Under most circumstances an oil with an API Service Classification of "SC" will be adequate. This oil will be mildly detergent and will have all of the additives normally required for this type of service.

But before we go too far into a discussion of oil, let's take a look at another classification listing for small engines:

1. Four-stroke
    a. Air cooled

2. Two-stroke cycle
   a. Water cooled
      i. Outboards
   b. Air cooled
      i. Lawnmowers, etc.
      ii. High-performance

Four stroke cycle engines are predominately air cooled and crankcase lubricated. They tend to run a little warm, so need an oil that has good antioxidizing characteristics. Other than that, their demands on the oil are not severe.

But with two stroke cycle engines the problems are entirely different. Some two stroke cycles, such as outboards, are water cooled and do not have a particularly severe oil oxidation problem. But since the oil is mixed with the fuel, and much of it goes into the combustion chamber, the additives contained in the oil can be particularly critical. Organic type additives tend to burn with the fuel, and do not cause severe problems. Mineral based additives, however, cause combustion chamber deposits and spark plug fouling. With all two stroke cycle engines, therefore, it is necessary to use a low additive oil or at least an oil relatively free of mineral base additives.

Air cooled two cycle engines fall into two general categories. One I will call the typical lawn mower engine which generally does not run faster than 3600 rpm, but due to the fact that it is air cooled tends to run hotter than water cooled outboards, and therefore must have an oil that is not only free from mineral additives, but also has a relatively good anti-oxidizing additive.

But it is the so-called high performance two cycle engines that really cause problems. High performance engines are snowmobile engines, chain saws, racing go-carts, motor bikes, and so forth. Some of these engines will turn up to 7000 rpm and faster and have severe high temperature problems. These engines need special oils and severe performance problems will be encountered if a low quality oil is used.

At the present time the Boating Industry Association is working on specifications or standards for oils for two cycle engines. There are two service classifications under consideration at present. They are:

TC-W

An oil specifically designed to meet the needs of two cycle water cooled engines. There are currently about 50 lubes on the market which meet these specifications.

TC-A

This is a set of specifications for oils for two cycle air cooled engines. Specifications and test procedures are now under development, but to the extent of my knowledge, no oils are being marketed as yet bearing this classification symbol.

In summary let me suggest that oils that are labeled "outboard motor oils" will perform with complete satisfaction in water cooled, outboard two cycle engines. Normally, they do not have the anti-oxidizing characteristics and other characteristics necessary for satisfactory performance in two cycle air cooled engines. As a general rule, and this is much more critical with the so-called high performance engines, use an oil that is either compounded by the engine manufacturer or is approved by the manufacturer for use in those engines. At the present time there is no one oil on the market that is completely satisfactory for use in all two cycle, air cooled engines. The proper oil costs very little additional money but can make a great difference in the performance of your engine.

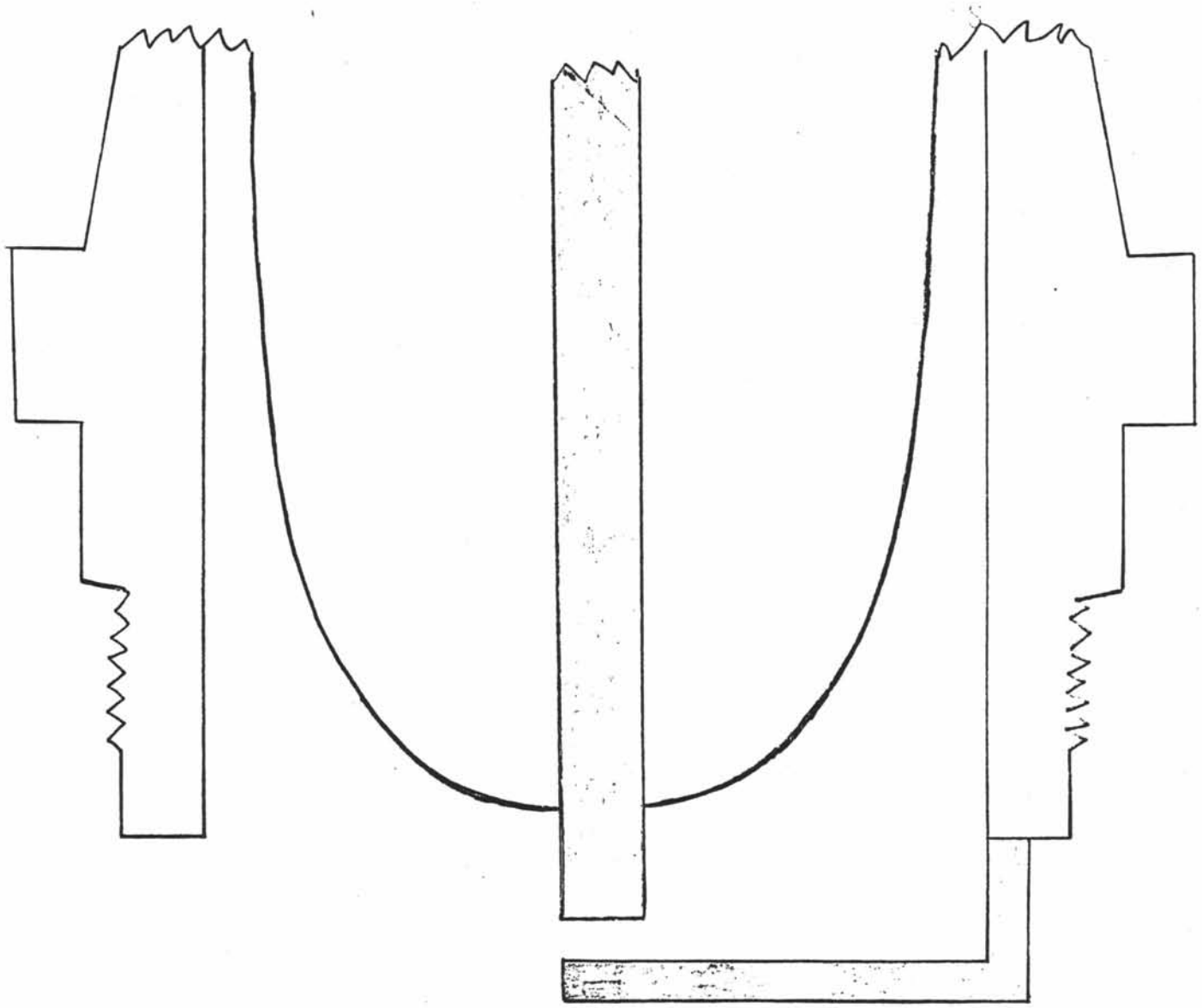

FIGURE 1

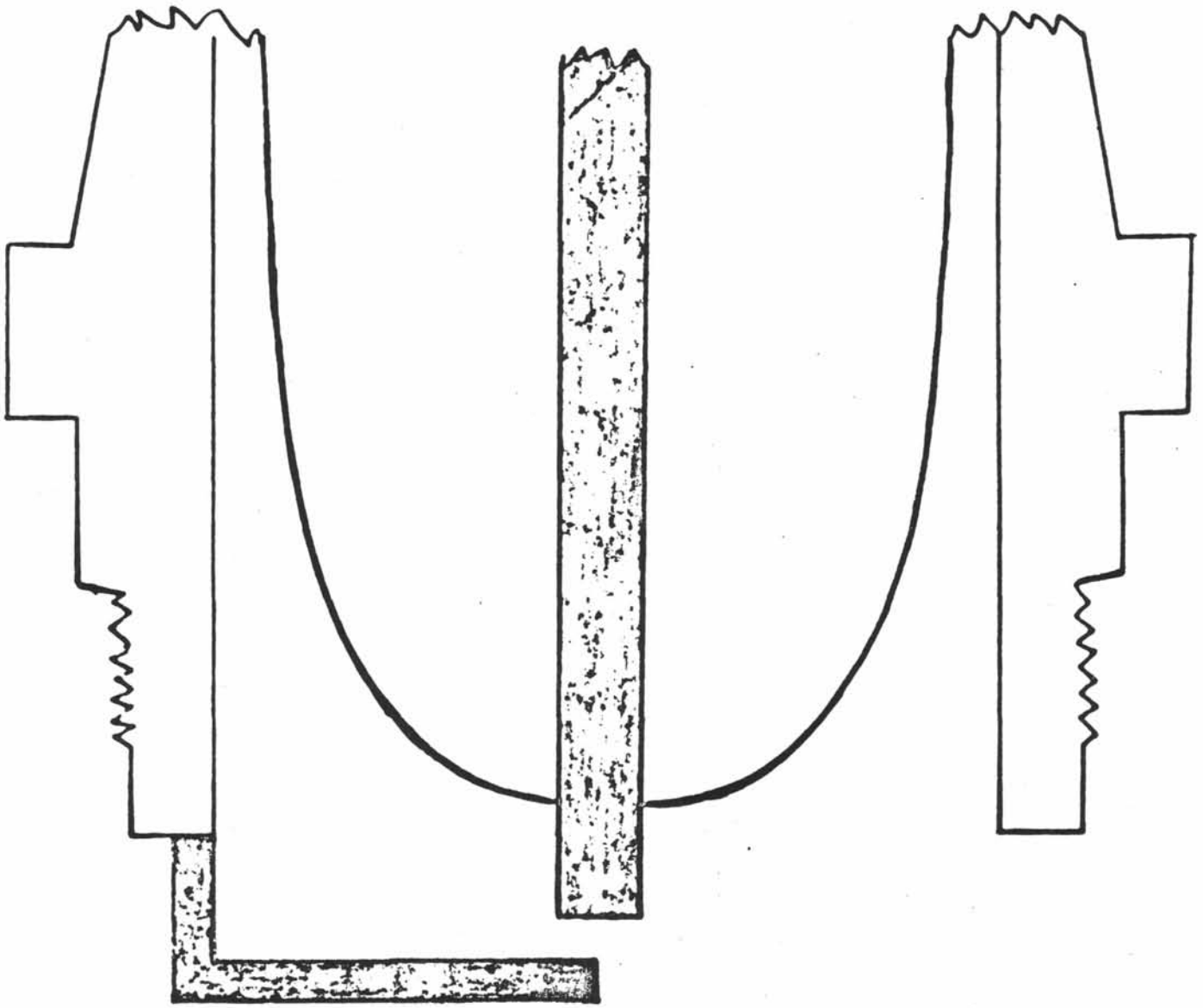

FIGURE 2