

Maintenance of Farm Machinery in Papua and New Guinea.

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Introduction.

MANY Territory farmers, both indigenous and European have spent large sums of money on agricultural mechanization. The machinery however is seldom looked after and money is wasted on costly replacements and repairs. Had some thought been given to the correct operation and maintenance of the machinery, this expense may have been avoided.

Whilst conditions in the Territory are improving, and specialist maintenance services are available in most major centres, replacement parts are still expensive and many farmers have to rely upon their own resources to keep their machinery in working order. When we consider the lack of trained mechanics and operators, the difficulties of the language barrier and the inability of the indigenous people to understand the technical terms, we realize it is the responsibility of the owner or manager of the machinery to understand fully the operation and maintenance of the machinery and also to ensure that his employees are properly trained and carry out his instructions.

Owner's responsibilities.

Booklets are usually supplied with items of machinery. These are the maker's instruction manual and the parts list.

The instruction manual usually covers not only the general principles of operation but also the special points applicable to the machine in question. Study of the book will acquaint the owner with the correct operating and routine maintenance procedures and will also assist him to decide when or if he will require the services of a mechanic to carry out the major repairs at the proper time.

The manual will also indicate the time when certain items will require replacement. Some items such as fuel filters and lubricating oil filters must be held in stock so that replacements can be made when required. The description and part numbers of these items may be found in the parts list.

The parts list is well worth studying. Many engines and machines often have modifications or alterations not readily apparent and unless the part required is properly identified and the correct part number quoted, the wrong part may be supplied and repairs to a machine held up for some considerable time.

The parts book may also show that some parts quoted will serve for other machines in use on the property. Such interchangeability may save holding excessive stocks of parts.

The owner should therefore study both the instruction manual and parts list, summarise the most important recommendations and purchase a stock of the replacement parts that will be required.

It is also essential to keep a log book for all engines and machines, recording the engine hours and operation of the machine, the fuel and oil usage and service details. From these records deterioration of performance can be checked before it seriously affects operating costs.

TRACTOR MAINTENANCE.

Fuel.

Fuel and fuel tanks should be kept clean, and free from water. If fuel and oil are stored in drums, the drums should be tilted to one side so that the two bungs are above any water that may accumulate on the top of the drums. Whenever possible fuel tanks should be filled in the evening after work. This will prevent condensation of moisture within the tank overnight. When pouring from a full container the aperture should be turned to the top. In this way much less will be spilled than when the aperture is turned to the bottom.

Cleanliness of fuel is very important for all engines and especially for diesel engines, in which particles of grit and moisture are the chief reason for breakdowns of fuel pumps and injectors. Diesel engines are fitted with several fuel strainers or filters through which the fuel passes before reaching the fuel pump. These filters must be cleaned and replaced strictly

according to the maker's specifications. Glass sediment bowls should be cleaned when required and care should be taken to clean and replace the gauze filter screens in the bowl.

Fuel pressure gauges should be checked regularly as a drop in the pressure is an indication of clogged filters.

Lubrication is required for the diesel fuel pump camshaft and governor. This is effected by filling the oil reservoir to the level mark on the dipstick. An S.A.E. oil of the same viscosity as the engine oil should be used.

FUEL INJECTION SYSTEM.

The three general types of Injection Systems in use are :—

- (1) Common Rail System ;
- (2) Pump or Direct Injection System ; and
- (3) Distributor System.

(1) *Common Rail.*

This system uses only one pump and distributes the fuel under pressure through a pipe or manifold to the injectors fitted to each of the cylinders. The injection is controlled by spring loaded valves which are operated by a separate mechanism or valve gear that controls the injection timing.

(2) *The Pump or Direct Injection System.*

Each cylinder is fed by an individual pump. Metering of fuel and injection timing is done by the pump and the engine controlled by varying the stroke and the volume of fuel delivered by the pump to the cylinder.

(3) *Distributor System.*

This differs from the conventional systems of one pump and injector cylinder in that it has one low pressure pump delivering fuel to a rotating disc assembly which delivers the fuel in much the same manner as a distributor on a petrol engine delivers electricity in rotation to the spark plugs. The fuel in this instance arrives at the injector under low pressure, the high pressure delivery being a function of the injector.

LUBRICATION.

Engine Oils. These have three main functions :—

- (1) The reduction of friction between moving parts ;

- (2) The cooling of rubbing surfaces ;
- (3) Sealing the cylinders to maintain engine compression.

Engine Oils may be classified under two headings :—

1. Straight Mineral Oils.
2. Detergent Oils.

The fluidity of the oil is directly related to :—

- (a) Easy starting ;
- (b) Quick acceleration ; and
- (c) Amount of oil passed through the bearings.

The lighter the oil the greater the fluidity. Straight mineral oils are highly refined, and contain no additives. Their use in engines, especially diesel engines has been superseded by the detergent type of oil.

Detergent type oils contain additives to combat impurities derived from combustion. Other additives give resistance to oilfoaming ; and the formation of oxidization material and sludge.

Oil is usually referred to by its viscosity rating or S.A.E. number. The lower the number the lower the viscosity and more highly fluid the oil.

Viscosity varies with temperature and it is important that the type of oil used should have the right viscosity for the range of operating temperatures and the type of engine for which it is used. It is therefore important to check the engine manual to ensure the correct grade and type of oil is used in the engine.

Detergent and non-detergent oils should never be mixed. Should it be necessary to change from mineral to detergent oil the engine sump should be carefully drained and flushed out with a clearing oil before filling with a detergent oil. It is necessary to drain all the oil from the engines at the times recommended by the manufacturer. The object of this is to keep the engine clean, so the engine must be drained before the foreign matter collected in the oil begins to settle or form into particles. Such materials are not normally collected by the oil filter, neither will they settle out by gravity but will oxidize and cause the piston rings to gum up and allow the compressed gases to blow past the rings into the sump.

GEAR OILS.

These are of two main types :—

- (1) Straight gear oils ; and
- (2) E.P. or extreme pressure oils.

Straight gear oils are specified in a few instances but the extreme pressure oils contain certain additives which maintain the lubricating qualities required for surfaces under pressure. Gear box and transmission oils do not require changing as frequently as engine oils. However, circumstances will indicate when an oil change apart from the routine change should be made. The fording of rivers, use in tropical rain storms, and muddy conditions have to be considered.

Oil Filters should be changed as recommended by the manufacturers' manual.

Greases. These may be classified as follows :—

- (1) Semi fluid or chassis grease ;
- (2) Ball bearing grease ; and
- (3) Special purpose grease.

Greases are a mixture of soap, oils and additives to give such characteristics as power of adhesion, heat and oxidization resistance, and resistance to climatical conditions.

Chassis Grease. Designed for use on slow moving plain bearings, track rollers, spring hangers and steering rods. It may also be used on implements such as disc harrows, ploughs and other agricultural implements.

Ball bearing grease. A more solid heat resisting grease recommended for ball and roller bearings, clutch bearings, and bearings provided with the Alemite type of fitting.

Special Purpose greases. For specified mechanisms such as water pump spindles.

The recommendations for both quality and quantity are important. Over lubrication by greasing can cause as much damage as insufficient greasing. Grease left on the outside of a nipple or grease point will collect dust and create an abrasive action detrimental to the machine.

The owner of machinery should familiarize himself with the lubrication requirements of his equipment and ensure that the operators of such equipment carry out the lubricating services when required, using the proper methods and correct grades of oils and grease. Hand oil cans should be clearly marked as to their contents and oil cans containing hydraulic fluid or penetrene kept

quite apart from the oil cans containing engine or transmission oils. The grades of oils and greases to be used should be entered in the engine log book.

Hand grease guns are made in various sizes from the 8 oz. push type hand gun to the lever type 16 oz. high-pressure gun. The handle and pump assemblies are all of similar construction, but different methods of loading the guns are used for the various types. High pressure bucket pumps are also available. These are designed to clamp onto the 45 lb. grease drums, and are ideal for greasing crawler type tractors and agricultural implements. Grease nipples are made in various designs. Among the more common types are the push-on nipples, the pin type, the hook-on type and the button head type of nipple as used on tractor track rollers. Such nipples are designed with a spring loaded ball which is depressed by the force of the grease entering the nipple and springs back on to a seat to prevent the grease from returning through the nipple. To ensure maximum efficiency of the nipple it is necessary to wipe all dirt from the nipple before attaching and using the grease gun.

Any dirt that may be forced into the nipple will contaminate the grease and either clog the hole in the nipple or affect the spring and ball.

Keep a stock of grease nipples handy and replace the damaged nipples at the first opportunity. Make sure the connector fits the nipple and where possible use a high pressure bucket in preference to a hand gun. Never grease to excess as besides wasting grease you may damage the inner seals by forcing them from their seats.

AIR.

Between 8,000 and 10,000 lb. of air are needed to burn one gallon of fuel, and depending upon the conditions under which the engine is operating this volume of air could contain sufficient dust to cause damage to the engine in a very short space of time.

To combat the dust menace, it is essential an air cleaner be fitted to the engine. This is a standard practice by manufacturers, but it is the responsibility of the owner to ensure the air cleaner is maintained in a serviceable condition.

Some air cleaners are fitted with a sight glass or bowl and the condition of the cleaner may readily be seen. Others rely upon the operator

of the machine taking into consideration the conditions under which the machine is working and cleaning the filter as the occasion demands. Besides cleaning the filter it is necessary to ensure all rubber connections are tight and in good condition. A choked air cleaner will lead to a loss of engine power and overheating.

COOLING SYSTEMS.

These may either be water cooling or air cooling systems. With *water cooling* the radiator must be kept full, and the radiator cap firmly in place. Should the water in the radiator be allowed to drop below the minimum the thermo syphon circulation of the water is broken and overheating will take place. Hose connections should be kept tight and not allowed to leak. Leaks may also occur at the water pump. Special water pump grease should be used for lubrication as other types of grease may cause clogging of the radiator tubes as well as failing to seal the water pump shaft or lubricate the pump bearing. The cooling system should be flushed out twice a year using a strong solution of washing soda. Run the engine for a few hours with the solution in the cooling system. Drain while the engine is hot and then let the engine cool before filling with clean rain water.

Keep the case of the radiator clean from grass and other foreign matter to allow the air free passage between the radiator tubes.

The fan belt should be kept at its correct tension. It should not be possible to depress the middle of the belt more than one inch.

Should an internal leak be suspected, fill the radiator to the brim and crank the engine over. If bubbles appear on the water, air is passing from the cylinders into the cooling system. Water, of course, will pass the other way during the intake stroke of the piston. To test for leakage into the sump, unscrew the drain plug all but the last thread. If there is any water in the sump it will come out before the oil. There will always be evidence of some water, especially if the oil has not been changed for some time, due to the condensation of vapour entering the engine breather. An internal water leak would, however, show a greater accumulation of water than would be from condensation only.

AIR COOLED ENGINES.

These have a cooling system composed of a direct coupled fan from which the air is directed around the engine. The engine and fan are enclosed by a shroud of metal duct work to guide the air around and over the hotter parts of the engine. The cylinder has fins integrally cast on to the outside to dispose of the heat generated. Such engines should be sited for maximum air flow. The shroud should be kept tight and free from obstruction. Air-cooled engines driving barn machinery should be so sited that they are afforded an unrestricted flow of cool air.

ELECTRICAL SYSTEM.

Regular attention and care of the battery will pay dividends in the form of many hours of useful service. When a battery is put in service with a truck or tractor care should be taken to ensure the battery support plate and holding down clamps are in good condition. A loose battery may jump about in its cradle with disastrous results, or if the holding clamps are too tight they may crack or warp the battery case. Avoid trouble here by carefully tightening the clamp wing nuts sufficiently to hold the battery firmly, and check the clamp at regular intervals.

Failure to keep the water level above the tops of the separator plates can seriously damage a battery, as plates exposed to the air become hardened and lose their ability to take a charge. Separators exposed to air will crack or split permitting active material to fall across and short circuit the plates. Little or nothing can be done for a battery badly damaged through lack of water.

Acid fumes or acid spilled on terminals and cell connectors will cause corrosion. The accumulation of this corrosive material sets up a high resistance to the passage of the current. The remedy is to keep the battery clean, wash off the corrosion with a soda solution and coat the terminals and connectors with petroleum jelly or mineral grease.

When fitting replacement battery always examine the old one and find out what caused it to fail. The fault may be mechanical or just pure laziness on the part of the operator. However, by finding the cause you stand a good chance of curing it.

The battery cables can give trouble for which the battery is often blamed. Frayed or corroded cables, poor connections or undersized cables will prevent quick starting and may cause damage to the coil or generator.

Spark Plugs. In a four-cycle engine running at 1250 RPM the plug sparks 600 times a minute or 36,000 times an hour and works in a temperature of 1,500 degrees Fahr. which is seven and a half times hotter than the water in the tractor radiator when it has reached its proper operating temperature of 200 degrees.

So it may readily be seen that the spark plug is designed to operate under extreme conditions. Always fit the recommended spark plug, as there are many different types and each type is designed for a specific duty. Clean and reset spark plugs after every 200 hours. Set the points to the specified gauge and make sure the copper sealing gasket is in good condition as this gasket plays a major part in conducting heat from the plug. The colour of the porcelain core and general condition of the plug will in many cases indicate the state of the engine.

TYRES AND TUBES.

Tyres and tubes may become expensive items if proper care is not exercised. All tyres should be checked at least once a week. Besides checking the inflation of the tube the valve should be inspected for tightness and to ensure that a valve cap is fitted. Under-inflation may cause as much damage as over-inflation. Under-inflation produces ragged irregular wear, increases flexing of the side walls and generates excessive heat. Over inflation causes faster wear to the centre of the tread, creates excessive pressure on both tyre and tube with the danger of a blow-out.

Some types of service in which tyres are used, subject the sidewalls of the tyre to a folding action when the correct inflation pressure is not maintained. A common condition causing this type of failure is in ploughing, where one tyre runs in the furrow and is distorted by the tilt of the tractor. The tilt of the tractor causes a side thrust of the weight against the tyre, which, combined with the heavy pull of the plough, causes the inner wall of the tyre to buckle. Continuous buckling or folding causes the cords to separate and the inner wall to split or tear.

The furrow wheel tyre pressure should be 4 lb. greater than that in the land wheel, provided that the maximum pressure is not exceeded. The plough hitch should be adjusted laterally so that the tyre does not crowd the furrow wall.

FARM IMPLEMENTS.

The chief causes of deterioration of agricultural machinery are abuse and neglect. Both may be the result of ignorance but are usually the result of laziness or irresponsibility.

Territory conditions are far more exacting than those in temperate regions for which in many cases agricultural machinery is designed. These conditions coupled with the fact that the indigenous operator has little or no mechanical knowledge may prove a high cost of turning from hand labour to mechanized agriculture.

A point that is often overlooked, is that implements if not protected from rust and climatic conditions will deteriorate almost as fast when not in use as those that are abused in use. Agricultural equipment most commonly used in the Territory is disc harrows, ploughs, rotary slashers, and trailers. With these the first duty of the farmer or owner is to ensure that the equipment is properly adjusted and attached before usage. Here once again it is advised to study thoroughly the operator's manual or manufacturer's recommendations.

With the three point linkage implements rapidly gaining favour in the Territory it is most essential that the sequence of operations for attaching, using and detaching the implement be strictly adhered to.

The Disc Harrow.

The disc harrow is more harshly treated than other implements. It is often expected to do more than it is designed for, and often, to effect better penetration, is overloaded with stones or logs. The implement requires frequent and thorough lubrication, the bearings being subjected to severe jolting pressure both vertically and laterally in addition to the pull of the tractor. The implement is constantly used in dusty or muddy conditions which make it imperative to grease the machine at least once every four hours. The discs should be kept tight to the shaft and sharpened, particularly when working in heavy trash. All bolts and nuts should be kept tight, and when storing

the implement it should be carefully cleaned, inspected for damage and finally treated with a rust preventative.

Disc Ploughs.

A disc plough must be set to suit the conditions under which it is to operate. The manufacturer supplies the implement set to suit average conditions and whilst these settings will provide a basis from which to start it will be found that the suggestions in the operator's manual can be applied to improve the work done by the plough. Ploughs should be lifted clear of the ground when turning a sharp corner or bend. Some types of trailed ploughs turn more readily to the left than the right. The discs are mounted on bearings protected from the dirt by oil seals. Their daily maintenance will include lubricating the furrow wheel, axle and disc bearings. After use the discs should be cleaned and coated with a rust preventative.

Rotary Grass Cutters or Slashers.

These may be either a trailed or semi-mounted implement designed to cut or slash grass or heavy undergrowth, and are used on plantations and holdings throughout the Territory. They range in size from the multiple head machine with a cutting width of eight feet down to single cutter hand propelled machines with a cutting width of eighteen inches. Most types employ a cutter head which consists of a horizontal rotating disc with blades mounted on the periphery of the disc. The tractor driven models may be operated over a wide range of forward speeds. Chains may be used in place of the cutting blades and are preferred by some for the eradication of grasses and bracken, as the chain will lacerate and shred the stalk whilst the cutter makes a cleaner cut but does not materially assist in the eradication of the bracken or grass.

Rotary cutters are dangerous tools when in the hands of an inexperienced operator. Before using the implement it is essential the cutter be checked for secure attachment to the tractor. The P.T.O. shaft should be properly attached and locked in place, and the shaft guard secured in position. Should the unit have a series of belts and pulleys to revolve the cutting head, these should be set at the correct tension, the idler wheels set into position and the cover guard replaced and secured. The cutters or chains should be inspected for security and the side guards checked.

Protection should be ensured for the driver and people who may be close to the machine, by fitting guards to prevent the chains or cutters throwing out stones and sticks.

After use the machine should be cleaned down and all grass and trash removed from beneath the cover. Trash will collect around the cutter spindles and lodge under the frame and unless this is removed the frame and guard plates will deteriorate and in time rust away. Trailled models will require greasing at the wheel bearings, the height adjusting screw and gearbox.

The Trailer.

Most accidents in the Territory involving tractors and trailers have been caused by incorrectly hitching the trailer to the tractor. With two-wheeled trailers the danger is greater than with the four-wheel trailers, as the weight transference is located down and behind the rear of the tractor and giving both units the tendency to "Jack-knife". The weight behind the rear tractor wheels causes the front wheels to rise off the ground; so ensure that the hitching point is safe for both tractor and trailer. Check the tyres for correct inflation and make certain that the braking system functions correctly.

As mentioned earlier the chief causes of implement deterioration are abuse and neglect. Instances of neglect in the Territory are:—

- (1) Machinery is seldom cleaned after use.
- (2) Greasing is haphazard and left to the whim of the operator.
- (3) Tyres are seldom checked for correct pressures and quite often allowed to go flat when the equipment is not required.
- (4) Machinery is left in the open and quite often is overgrown by grass or vines.
- (5) Winnowers and harvesters left with the trash in the sieves and body of the machine. The resultant corrosion leads to the expense of repairs and replacement parts.
- (6) Tins of grease are left with the lids off and grease guns and oil containers thrown in the dust.

These examples are but a few of the costly causes of implement deterioration. The life of most agricultural implements is indefinite but with proper care most machinery of this nature should have a useful life up to ten years, but the increasing changes in design and consequent

lack of replacement parts plays an important part in the economic life of agricultural machinery.

TOOLS.

Most tractors and implements are supplied with the tools required to carry out small adjustments to the machines. These in many instances are crudely made and poorly designed. It will be necessary, therefore, before minor overhauls are to be made to any major items of plant, to invest in some items of workshop equipment and hand tools. Before any such purchases are made examine the machinery and list the probable work to be done.

Satisfy yourself whether open ended, ring or socket spanners will be required. Tool kits may be purchased containing ring spanners, socket sets with articulated handles and braces, screw

drivers, pliers and hammers. Other requirements may be listed as follows :—

- (1) Pliers. Wire cutting. Long nose. Slip Jaw.
- (2) Screw Drivers. Stub handle. Insulated sets.
- (3) Punches and cold chisels.
- (4) Hammers. Ball pein. Sledge. Mallet.

For the Workshop.

Jacks, Hydraulic.
Block and tackle. Chain hoist.
Vice, 4-inch jaw. Offset.
Tap and Die sets, British and American.

Miscellaneous.

Hacksaws, feeler gauges, files, wire brushes, carborundum stones, bench grinder, oil cans, tin snips, tyre repair outfit.