ROTHAMSTED RESEARCH

Power for Cultivation and Haulage on the Farm

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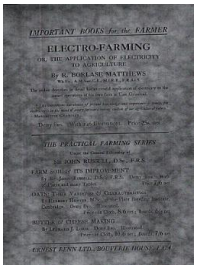

The Care of the Tractor on the Farm

G. W. Watson

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will give a strong lead to the extended use of the tractor in this country, which will restore the agricultural industry to its right and proper position and so benefit the community at large.

THE CARE OF THE TRACTOR ON THE FARM

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An agricultural machine or implement usually suffers from the simple fact that it is an inanimate object—*i.e.* it is without life or soul. Whilst most owners will give some measure of personal attention to even the meanest and least profitable animal on a farm, there are many who, having bought a machine, turn it over to a heavy-handed individual who has no knowledge of its construction, no interest in its success, and little or no inducement to acquire that knowledge or stimulate an interest.

Tractors may be divided, roughly, into two broad classes—firstly, the petrol or paraffin class; and, secondly, the steam class. I propose to confine my remarks to the former.

If an engine starts up at the first swing and runs with a healthy purr, indicating that all is well, a driver feels that he has made a good start for the day. This feeling of satisfaction is amplified if the engine answers to the throttle, and pulls in the field as though it took a real interest in its work. In the case of an engine that has been in use for any length of time these results are not obtained without trouble, but it is surprising how long an engine will keep in good condition if it receives consistent attention, and all adjustments are carried out as soon as they become necessary. Apart from the actual breaking of a vital part the diseases from which an engine suffers can be classified, roughly, under the general name of troubles, as follows: ignition, fuel supply, lubrication, valves, and water circulation. To this list of evils may be added knocking or noisy sounds, which are not evils in themselves but are simply warnings that all is not well.

Ignition.—It is of vital necessity to keep the coil or magneto free from damp, because if the condenser becomes damp it will not only cause leakage and failure of the ignition but will not hold any charge, and the resulting spark will not be efficient. Great care should always be taken to avoid spilling water over either coil or magneto, and should any be spilt thereon it should at once be

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mopped off, and, if necessary, dried off by warm air from a lamp or stove, but care should be taken not to raise the temperature of the part so much as to melt the wax or shellac insulation.

I will now deal with some of the more common troubles experienced with ignition systems:

Misfiring.—The driver who knows his engine occasionally detects an alteration of its note or an interruption of its regular hum. This, if accompanied by a falling-off in power, is probably due to occasional or persistent missing of one of the plugs. When compression taps are fitted it is easy to locate the faulty plug. If all the plugs are firing badly, the fault may be either in the petrol supply or in the ignition. If only one plug is missing, the trouble can at once be set down to ignition alone, or, on rare occasions, to a valve being stuck open.

Faulty Plugs.—Apart from actual damage to a plug by breaking the porcelain or other insulation, there are three main evils from which it may suffer. Short-circuiting may take place between the points and the body, due to the hot spark having melted the metal. The gap of the plug may be too wide; it should not be more than about $\frac{1}{50}$th of an inch, or, roughly, the thickness of the average thumb-nail. If the engine misses when running at small-throttle openings the points of the plugs should be set a little farther apart, whereas, if missing takes place at full-throttle openings the points should be set closer together. The third evil is due to sooting up, and is cured by cleaning with a little petrol.

An occasional cause of missing is through having the points set in a pocket in the valve cap. This pocket remains full of spent gas left during the exhaust stroke, and a considerable improvement can be obtained by fitting plugs with a longer reach.

The Magneto.—The magneto may be the cause of irregular firing in any or all of the cylinders, but tampering with a magneto is a pastime not to be recommended unless a driver understands it. There are two points, however, to which occasional attention is required, these are the high-tension distributor and the contact breaker. This distributor disc should be cleaned occasionally with a cloth and a little petrol, and the disc wiped over afterwards with a trace of oil. The contact breaker is the most important part of the mechanism. The space between the platinum points when they are separated should be about $\frac{1}{64}$th of an inch, and any variation from this may cause ignition trouble. The contact points should be trimmed when necessary with a very fine file, so that they bend together level when closed, but they should not be trimmed unless the points are uneven. Oil should not be put on the platinum contacts, or it will cause them to burn away rapidly, Occasionally the lever to which the moving point is attached works stiffly, allowing the points to remain apart; in such a case the fibre bush should be

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eased slightly. Oiling is of no use, as it may make it swell more. If these various points receive proper attention, there is little to go wrong.

A few warnings concerning magnetos:

Don't run the engine with a plug wire disconnected—you may ruin the insulation. If you want to cut out a cylinder, short-circuit the plug—that is, connect it directly to the metal of the engine.
Don't swamp the magneto with oil—two or three drops of good oil once a week are sufficient.
Don't oil the contact breaker.
Don't use an oil-can with dirt on the spout.
Don't file the contacts more than is absolutely necessary.
Don't hold the contact breaker to prevent the spindle turning when tightening up the nut of the driving coupling.
Don't fail to see that the earth wire is not making a short-circuit.
Don't hang plug cables on the exhaust pipe.
Don't replace plug wires on the wrong terminals.
Don't tamper with a magneto unnecessarily.

Motor Fuels.—Every driver knows that if petrol is poured on the hand it evaporates with a marked cooling effect, due to the petrol extracting heat from the hand. In a carburettor, fuel is supposed to be split up into a fine spray, and the heat for its vaporization is extracted from the air. Any cracks or leaks in the pipe which heats up the air to the carburettor should be repaired at once.

The jets in a carburettor are usually very small, and it is very necessary that all the fuel should be carefully filtered before it is put into the tank; as an additional precaution there should be a filter between the tank and the carburettor. These filters should be cleaned regularly, and any drops of water found therein carefully blotted up.

"Popping back" into the carburettor indicates a weak mixture, and is one of the first symptoms of fuel-supply trouble. Such a mixture burns slowly, and may still be burning when the inlet valve opens, thus allowing some of the burning gas to rush back into the carburettor. If the engine has been running normally and popping suddenly develops, look for some stoppage in the fuel supply. First try the float needle, and if the petrol does not flow into the float-chamber, although there is plenty in the tank, there is undoubtedly a stoppage in the pipes or the filter, both of which should be thoroughly cleaned. Such stoppages are frequently caused by small particles of scale from the tank, pieces of waste or fluff, or by drops of water which will not pass through the filter or the jets. Many engines have a tendency to pop back when

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first started, from cold, but work satisfactorily after they have run a little time and become warm. The explanation of this has already been given in the paragraph dealing with hot-air supply.

Occasionally a float sticks, or is held up by grit, or the needle becomes bent or jammed, causing the carburettor to flood. Flooding may also result from a punctured float, in which case the petrol can be evaporated and driven off by immersing the float in hot water, and at the same time the issuing bubbles will show the position of the hole, which should then be soldered neatly, or, in the absence of solder, a temporary repair can be made by wiping a piece of soap over the hole.

A leaky joint in the inlet pipe may cause much trouble by weakening the mixture, and in an old engine leakage of air along the valve stems, due to wear in the guide, may have the same results. All joints should therefore be kept tight and leakages stopped as far as possible.

Very briefly, fuel-supply troubles and their remedies may be summed up as follows:

Engine pops back and stops: no petrol in tank, petrol pipe choked, filter stopped up, or water in petrol.

Engine pulls badly on hills: insufficient heating, or jet too small.

Engine flabby and exhaust offensive: jet too large, causing rich mixture.

No acceleration and engine staggers when throttle is opened: engine cold, or mixture too weak.

Carburettor floods: needle valve sticking, dirt under needle, valve or float punctured.

Consumption excessive: engine or transmission in bad condition, jet too large, ignition retarded, leakage of petrol, or brakes binding.

Let me here give a word of warning to drivers. A carburettor is a delicate piece of mechanism, but if properly fitted and treated carefully it rarely gets out of order. No driver should be misled by an engine knock to believe that there is something wrong with the carburettor, as under no circumstances can this be the case. Again, many drivers always blame the carburettor if an engine suddenly heats up, whereas the probable cause is that the fan belt is slipping, that there is no water, that the water-jacket is choked up, that more oil is needed in the crank-case, or because the ignition is retarded too much. Overheating is never caused by too much gas.

Lubrication.—Lubrication means the introduction of a separating film of oil or grease between two parts of a machine which have movement one upon the other. If the moving parts make actual

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metallic contact the surfaces will soon become roughened to such an extent that they may seize. The higher the speed of rubbing the sooner seizure will occur, and its consequence will be more serious.

Some parts of motor vehicles are designed so as to create friction, but such parts are few, and are for special purposes—such as the main clutch, the brakes, the fan belt and the tyres.

Of all the sources of friction in an engine, that of the piston against the cylinder wall is the largest item, and is double or treble the total friction of all the other parts of the engine put together.

Valve Troubles.—Valve trouble is usually indicated by a gradual falling off in power. On examination the valve faces will be found scored and pitted, and it is necessary to grind them down on to their seats to again produce a clean face. If the face is very deeply pitted, it may be necessary to clean it up in a lathe, after which it should be ground to a true bed on the seating. In an old engine the seatings themselves may become rough, and necessitate truing up with a special tool, or, if not too bad, an old valve can be used for this purpose with a slightly coarser grade of emery, finishing off with fine emery and the proper valve.

The operation of grinding is a perfectly simple one, but requires to be done with care. Only the very finest flour-of-emery powder, mixed with lubricating oil to form a thin paste, should be used. This should be spread evenly on the valve face, and under a slight pressure the valve turned first in one direction, then in the other, occasionally lifting it and turning it through about half a turn before letting it drop on the seat again. This is to prevent the emery getting into tracks. If a light spring is slipped under the valve head, and is long enough to lift the valve from its seat, it will be found a great convenience, as on relieving the grinding pressure the valve will be lifted and it can then be twisted as much as is necessary before pressing down again. The exhaust valves suffer most, due to the hot gases sweeping across their faces, and it is for that reason that one usually allows a little more clearance for the exhaust-valve tappets than for the inlet-valve tappets, so as to make quite sure that the valves really do close. When grinding in valves it is of course necessary to take care that none of the emery paste enters the cylinder or gets on the valve stem, and the valve, valve port and guides should be thoroughly cleaned before reassembling the parts, oiling the valve stems during the process. After regrinding valves it is usually necessary to re-adjust the tappet clearances, carefully tightening up the lock-nuts so that they cannot work slack. Each valve should be examined in turn to make certain that it is never held off its seat, nor has too much clearance—the clearance should never be less than $\frac{1}{64}$th of an inch, and never more than about $\frac{1}{32}$nd of an inch—but in order to get the quietest and best running it is advisable to adjust the

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tappets while the engine is still hot and the valve stems expanded to their maximum amount. It is not always easy to see if the clearance is right, especially if the head of the valve tappet is much bigger than the end of the valve; the tappet head may be a bit soft, and the end of the valve then punches a slight depression into it, so that the clearance is really more than it appears to be. It is, however, always preferable to have too much rather than too little clearance, as, although the engine will be noisy, there is less fear of burning out the valves.

If for any reason a camshaft has to be removed, careful search should be made for any marked teeth, and care exercised that the teeth of the timing gears are again correctly meshed when putting the camshaft back again. Occasionally, a valve sticks in the guide, due to insufficient lubrication, or it may be that the valve stem has warped. If a spot of oil on the stem is not sufficient to make it operate again the valve should be removed, and the stem rubbed down with a piece of emery cloth, or, if badly warped, carefully straightened in the jaws of a vice, after which it may be necessary to regrind the valve on to its seat. If the engine is provided with screwed valve caps the threads should be smeared with graphite and oil before replacing the caps, otherwise they may seize and be very difficult to remove. A driver should make quite sure that these are screwed up quite tight, and that there is no leakage. A simple test for leakage is to pour a little oil round the joint when the engine has been started, when any leakage will be at once apparent by the oil being blown away from the joint.

Cooling.—In small engines it is possible to rely on air-cooling, as on motor-cycles, but in larger engines a water-jacket is provided, and water circulated through this either by pump or natural circulation. In most cases it is usual to provide a fan to assist the cooling of the water as it passes through the radiator, and the fan belt should be kept at the proper tension, otherwise there will be slip.

Water-cooling troubles make themselves evident by steam being generated, but so long as steam is not blowing away, even if the radiator is uncomfortably hot to the hand, there is no danger, as an engine works best when the water is just below boiling-point. Like most complaints of engines, overheating may be of gradual growth, or it may develop suddenly. In the former case it means that the water-jackets and radiator have become coated with scale such as we find in a domestic kettle, except that the scale may also include rust and grease. Scale interferes with the passage of heat to a very great extent, but much of it may be removed by filling the jackets with a hot strong solution of common soda, then after leaving it to stand all night, drain it off, and thoroughly wash out with clean water. Soda must not be used if the radiator or pipes

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are made of aluminium, because soda is injurious to this metal. In such a case it is better to use Boilerine Tablets, or a solution of carbon tetrachloride.

If overheating shows up suddenly on an engine that has previously given no trouble, we must look for a broken or slack fan belt, a faulty pump, or leaking joint allowing water to escape, or the accidental opening of a drain tap. The most serious cause of overheating, however, is a cracked cylinder, as a very minute crack will allow gas to escape from the cylinder into the water-jackets, and the water will quickly boil. Some drivers appear to have difficulty in making tight joints in rubber connexions, but if a little rubber solution is smeared on the pipe it will not only act as a lubricant, but when it sets it will ensure a good joint.

Transmission Gear.—The transmission gear commences with the clutch and finishes at the road wheels. The two main portions of a clutch should disengage positively when the clutch is out, so that there is no dragging on the gearshafts. If the clutch becomes greasy it will slip, causing heating, and probably burning the lining, while if it is allowed to become fierce, it makes starting difficult, and throws undue load on the transmission system. A slipping clutch may be caused by insufficient spring pressure, the lining being badly worn, or worn so as to leave a ridge which prevents the cone entering any further, in which case the ridge can be removed with a chisel, sharp knife, or file. If none of the above causes is present, but the clutch still slips, a new lining should be fitted as soon as possible. Meanwhile, as a temporary expedient, thin strips of metal can be inserted underneath the lining between the rivets. A fierce clutch may be caused by too much spring pressure, or by the rivet heads standing proud of the lining, in which case the clutch will slip a little at first, and then take up suddenly. The remedy is to drive the rivets further in with a punch, so that they are below the surface of the lining. Another and frequent clutch trouble arises from the centre or spigot bearing becoming so worn as to allow the clutch cone to sag, and fall out of truth with the fly-wheel. This makes gear-changing a very difficult matter, because the clutch is never really free. If a clutch slips badly, the first thing to do is to wash the lining with petrol, and if the lining is of leather it should then be reconditioned by dressing it with castor oil or collan oil and leaving it to stand disengaged overnight, so as to allow the oil to soak in. If, however, the lining is of fabric, no oil should be put on it. As a temporary measure for a slipping clutch, it should be dusted over with fuller's earth, or, in the case of a fierce clutch, with powdered graphite, or french chalk.

Multiple-disc clutches are now frequently used, some of them being enclosed in an oil bath, whilst others are of the dry type. In

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the oil-bath type the case should occasionally be drained and washed out with paraffin and new thin mineral oil then put in. If thick oil is used it is liable to become sticky, and may cause slipping, whilst mixtures of engine oil and paraffin should never be used.

Between the clutch and gear-box many vehicles are provided with a small brake or clutch stop, the object of which is to bring the rotating parts of the gear-box to rest when the clutch is out, so as to make gear-changing easy. Attention should be paid to this small brake to see that it is neither too fierce nor too slippery.

The next link in the transmission is the change-speed gear-box. It should be supplied with the right quantity of suitable oil and occasionally drained, washed out with paraffin, and a supply of fresh oil then added. This cleansing and replenishing is necessary because, no matter how carefully used, fine particles of metal dust or chippings become separated from the gears, bearings, change-speed forks, etc., and if allowed to accumulate they cause extensive damage. The ideal lubricant is a good heavy mineral oil, but unfortunately some boxes will not retain it, and in such cases it is a common practice to mix oil and grease together; neither must be of the kind which produces a soapy mixture, because this implies the presence of acid, which will etch highly polished surfaces and cause damage. As a general rule the thinnest mixture of lubricant the box will retain should be used, not only because it flows freely to every part, but because it offers less resistance to the gears.

From the gear-box the drive is transmitted to the driving wheels through chains or a propeller shaft to the rear axle. If chains are used, it is useless to attempt to lubricate by pouring oil on to them. The only effective way is to remove the chains, wash them thoroughly in paraffin, drain them, and then soak them in a bath of hot grease and graphite, and again drain them. Any excess of grease should then be wiped off, or it will collect dust and grit. If chain-cases are provided they should be maintained in an oil-tight condition, and the oil kept up to the proper level. The chains should be kept at a proper tension—a little slack, but not slack enough to flog.

If universal joints are not properly lubricated, wear will take place, and backlash develop and damage all keys and gearing. The back-axle or differential case requires the same attention as is given to the gear-box. If pieces of metal are found on filtering the oil drained from casings, something is wrong, and the matter should be reported at once, or serious damage may follow.

Conclusion.—As a final word let me add that the best possible way of reducing the cost of maintenance of a tractor is by giving close attention to the matters which I have mentioned. If this is done, and the brakes and steering connexions are kept properly adjusted and all nuts and bolts kept tight, there is little to go wrong

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in a modern machine, apart from fair wear and tear, calling for the replacement of worn parts by new ones. If the care which I have advocated is not given regularly, abnormal wear and tear will take place, heavy costs for renewals will be incurred, and the value of the machine will rapidly depreciate. I would again urge owners of tractors to treat their machinery as they would treat their animals. If they do so, they will find themselves well repaid.

PRACTICAL EXPERIENCE OF POWER ON THE FARM

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I PROPOSE to deal in this paper with the application of power in my immediate district, and chiefly on my own farm of 330 acres, of which about 225 are under cultivation. The soil is a sandy loam, and with three exceptions the fields are fairly level. The farming in the district is based chiefly on corn, cattle and sheep; there are some farmers who produce milk, and some grow potatoes on part of the root break. My practice has been to depend chiefly on the live-stock department—on sheep, pigs and poultry—and on the arable land; to widen the range of crops by growing a considerable acreage of potatoes, carrots, parsnips, peas and green vegetables, in addition to corn and the usual roots. I have grown sugar-beet during the last three years. My farming, therefore, may be described as semi-intensive—organized, it may be added, as a business proposition.

The following figures, extracted from the annual reports of the Ministry of Agriculture, show a steady decline in the number of horses on farms in England and Wales:

	Horse-Power	
	Horses, Mares and Colts	*Acres of Arable Land*
1911-1915 . . .	1,165,000	11,131,000
1916-1920 . . .	1,134,000	11,805,000
1921-1925 . . .	1,064,000	11,144,000
1925 . . .	967,000	10,682,000
1926 . . .	927,000	10,548,000
1927 . . .	894,000	10,310,000

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