HYDRAULICS

Roland Taylor looks at the history of something which has made all our lives easier

In these days of high technology it is easy to forget all the research, time, sweat, sleepless nights and money that was put into developing something we use everyday and simply take for granted. Hydraulics is a case in point.

By having a better understanding of hydraulics, how they work and their maintenance requirements is of considerable benefit in achieving optimum performance and identifying the possible cause of a failure.

Hydraulic power, or fluid power as it is sometimes known, involves liquids in motion or under pressure. This force has been used for centuries, but it was not until the 1650s that a Swiss scientist Pascal, and physicist Bernoulli, formulated hydraulic power laws which are still used in modern applications. It was nearly 200 years before these laws could be applied, thanks to the invention of mechanical pumps. By 1882 the City of London had installed a pressurised water system that delivered supplies, through underground mains, to factories, for running the machinery. The next milestone was in 1902, when the American warship, the USS "Virginia", was fitted out with an oil hydraulic system to control its guns. Eighteen years later the first self-contained unit was introduced.

A man who played a significant part in the development of hydraulics, was tractor manufacturer, Harry Ferguson. Although there was no direct link with golf then, his tractors and other manufacturer's models, that used his system, eventually found their way onto most courses. These units were the forerunners of those now found on modern machines.

In 1936, Ferguson launched the "Black tractor" onto the agriculture market, it had a unique integral hydraulically controlled three-point-linkage. Within a decade most tractor and implement manufacturers throughout the world, had copied the system.

Since the last war the growth of fluid technology has been phenomenal and when it comes to transmission systems, hydraulic power leads the way.

HOW DOES FLUID POWER WORK?

It basically involves controlling the circulation of a pressurised fluid, to a motor, which converts it into a mechanical output that works satisfactorily under load. The main benefits of this system are its flexibility, the ability to multiply a force efficiently. In addition, response is accurate and faster than any other power transmitting system. Even under varying loads a precise speed can be maintained. A single lever controls the transmission unit's speed and smoothly alters the direction of travel without a clutch being engaging and the manually changing of gears. This is a big plus when working in confined areas or using a loader. As part of a piece of machinery's overall design the number of mechanical drive components is greatly reduced.

The link between the pump and motor is not rigid so a hydraulic system is very flexible. Often the motors are a considerable distance from the pump. These features can be seen in machinery such as, long reach flails or a ride-on triple with floating cutting units, so they closely follow the terrain.

A hydraulic system consists of the following, a tank or reservoir, pump and motors, plus control valves and hoses.

The tank has to be large enough to supply the whole system plus a reserve supply. As the oil passes round the system it heats up, mainly due to the friction, created by the moving parts, so it needs to be cooled before being re-circulated. At some point before it is returned to the tank, the oil passes through a cooling unit, which generally consist of a fan, either blowing or drawing cold air through cooling fins.

The pump's function is to create a pressurised oil flow.

Depending on the application, there are generally of two types of motor used, in hydraulic systems - linear or rotational.

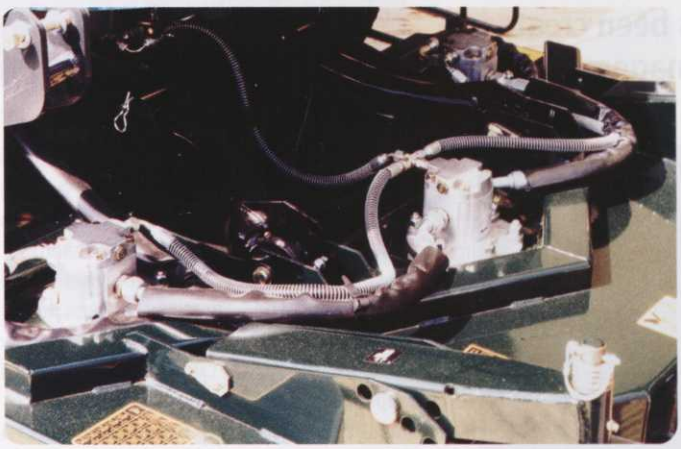
The linear unit consists of a piston inside a cylinder (RAM). A piston rod connects the force that is created to the external load. As these units generate force in a straight line they are used on turf machinery for lifting or lowering units. On tractors this type of motor is mostly used to operate the three-point-linkage and power steering.

In a rotational motor, pressurised oil drives the gears, vanes or pistons, this produces torque on the output shaft. They are used to drive cutting cylinders and wheels.

Special hoses and connectors have to be used because the oil is under considerable pressure.

Self-contained hydrostatic transmissions are very popular and these are generally found on the small estate and garden tractors, some ride-ons and pedestrian rotary and cylinder mowers.

All systems have some form of by-pass valve for moving the machine, without the engine running. These are also generally used to bleed the system of air.



TAKING CARE

On most systems, maintenance is relatively minimal, there are however a number of other factors that need to be taken into account to ensure continued optimum performance and long life.

The components of the pumps and motors are manufactured to very fine tolerances so if the oil becomes contaminated with dirt, then serious internal damage can occur. If water gets into the system it will create major problems.

From time to time the reservoir tank will need to be topped up. Make sure the recommended hydraulic fluid, as shown in the manual, is used.

The manufacturer will have carefully routed all the hydraulic hoses and secured them with some type of fastening. During work these fasteners can become damaged, break or lost, as a result a hose may then chafe against another part of the machine. If this is not spotted and dealt with, a hole eventually forms and bearing in mind that the oil is very hot and under pressure a very unpleasant situation could occur, which endangers, the operator and also badly damage the turf.

Connectors are a point where foreign bodies can enter the system, so these need to be kept clean and checked regular to ensure they are working correctly.

As already mentioned, it is important that the oil is kept at the correct temperature. Two things can affect this - the lack of oil or an ineffective cooling system. To avoid the first one, it is necessary to check the levels periodically, as recommend in the instruction manual. Also be on the look out for any signs of leakage, such as small pools of oil on the floor area where the machine is stored. Some manufacturers such as John Deere, now offer a hydraulic oil leak detection kit for some of their machines. If these detect a leak an audible alarm and a warning light warn the operator.

Cooling fins are often used to keep the fluid at the correct temperature. These can become clogged up with dried grass and dirt, as a result the airflow across them becomes either restricted or non-existent. Regular inspection, and cleaning if necessary, will avoid these hot spots occurring.

OTHER WARNING SIGNS

There are other signs that may indicate a problem to watch out for. If a unit is showing loss of power, noisy, not working or the oil is foamy, then air may have entered the system. The answer in this case will be to bleed the system. As each machine has a different system it is necessary to consult the users manual.

A point that is shown in the John Deere instructions, for bleeding a system, is obviously very important and should be checked out regarding other makes of machines. They state that pumps should never be bled or purge under load as this could seriously damage them. It also says that the machine needs to be jacked up so the tyres are off the ground when carrying out this operation.

BIODEGRADABLE OIL

Apart from the environmental issue, these have another advantage. In the event of an accident where hydraulic oil is sprayed onto the turf, damage will occur because of the heat, but there is a high chance of recovery.

Before proceeding to use biodegradable oil you need to check with the supplier or manufacturer of the equipment to ensure they endorse the use of it. There are some operations where it is not recommended. The other down side is the cost, it is more expensive that normal oils.

John Deere says in their literature, that there are other factors that should be taken into account, these include, increased oil change costs and possibly higher maintenance bills, especially where systems are working at high temperatures and with heavy loads.

Where biodegradable oil is being used there are signs to be on the lookout for. If the fluid becomes black there is probably an overheating problem. Where it is milky then the chances are water is in the system. The fluid needs to be cold to obtain its correct level.

Hydraulic power has over the last few decades played a significant part in the efficiency and cost effectiveness of a majority of equipment used on a golf course. Maintenance requirements and schedules have been considerably reduced in recent years, but it is still important that if maximum output and long life are to be achieved, regular checks are carried out and any faults identified and rectified as quickly as possible.

With any hydraulic system a watchful eye can often spot a minor problem before it becomes a major one, so always be vigilant.