HYDRAULICS ARE AN ASSET IF YOU UNDERSTAND THEM

Hydraulics *provide flexibility and reliability if understood.*

Imagine how complex and cumbersome turf equipment would be today without the hydraulic systems we take for granted. To perform the same functions, mechanical alternatives would add considerable size, weight, service requirements and operating cost.

For the operator, hydraulic systems not only have taken over most of the manual effort, they also have greatly improved and simplified control.

With just the touch of a lever on one of our sweepers, five cubic yards of debris can be raised 8-½ feet and discharged to a waiting truck.

Reels of many Jacobsen machines no longer rotate by traction. Hydraulic systems turn the reels at a selected rate, assuring a consistent cutting frequency independent of forward motion or wet or heavy turf.

Because of hydraulics, mower gangs on turf tractors steer with the machine and can be swiftly raised to negotiate narrow areas or for transport.

Hydraulics ease steering and the use of a three point hitch, raise and lower cutter decks and snow blades, and provide a form of automatic transmission with exceptionally simple control.

But even though hydraulic systems have become commonplace and preferred, some operators may not understand them. Knowing what they are and how they work can be a great advantage when the time comes for maintenance, troubleshooting and repair.

Advantages

The basic advantages of hydraulics over other forms of power transmission are many.

Simple Design—A simple combination of pumps, valves, motors and lines replaces more complex systems of mechanical linkages, gears, cams and levers, reducing maintenance costs and increasing reliability.

Compact Power—Hydraulic components provide more power in a smaller package than the mechanical or electrical devices that would perform the same function.

Flexibility—Because power is transmitted through tubes and hoses, hydraulic components can be located more advantageously.

Control—The power transmitted can be varied infinitely between wide limits for simple, precise and safe operator control.

Reduced Downtime—Built-in

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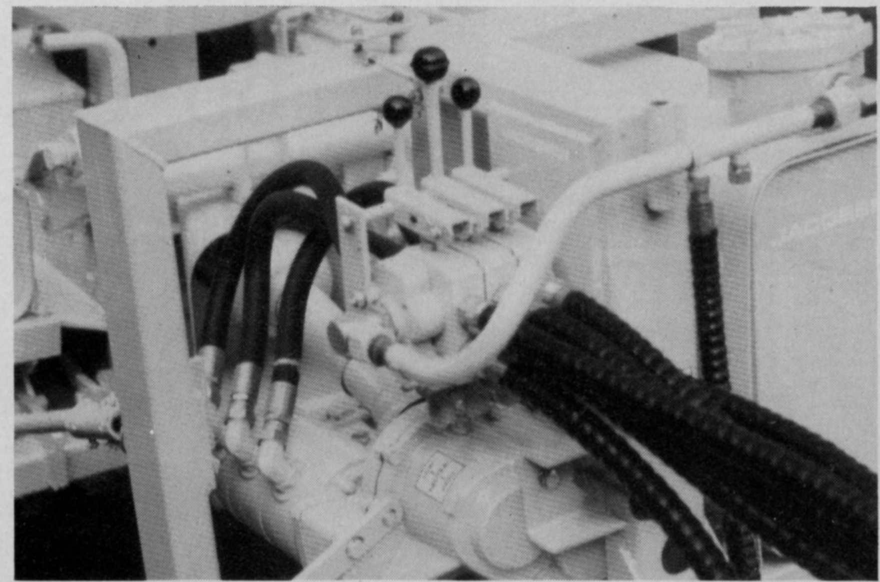
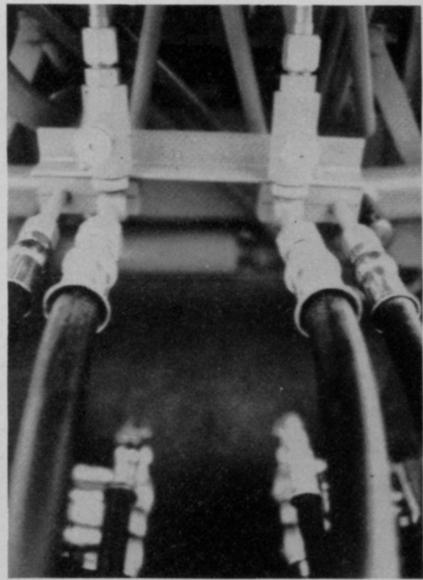


Components *of a pull-behind gang mower hydraulic system include filter (upper right), tank (below filter), valve bank with controls, and the pump (lower left).*



Flow control valves *allow for backlapping the reels while in place.*

relief valves provide overload protection keeping downtime and maintenance costs at a minimum.

Smooth & Quiet—Because force is transmitted through a fluid, hydraulic systems are exceptionally smooth and quiet in operation.

Basic definition

Basically, hydraulic power can be defined as the use of liquids under controlled pressure and flow to do work. Pressure exerts a force in the system, transmitting it in a confined liquid through hoses and piping. It is expressed in pounds per square inch. Flow causes motion. It is expressed in the number of gallons per minute that pass a given point.

System components

A basic hydraulic system is simple with fewer than a half dozen principal components.

Fluid Reservoir—The reservoir performs a variety of functions besides holding hydraulic fluid. Its walls are designed to dissipate the heat in the return oil. Baffles prevent the hot return oil from flowing directly to the outlet tube. They also help prevent turbulent flow which might allow air to mix with the oil, causing spongy operation and excess heat that could damage pumps. Often reservoirs are equipped with magnetic drain plugs and filters to capture dirt particles.

Pumps—The pump converts mechanical power into hydraulic flow under pressure. Its size, or displacement, and speed determine the amount of flow in the system which, in turn, governs the operating speed of the hydraulic motor or cylinder.

A design commonly used in systems requiring up to 3,000 pounds per square inch of pressure is the gear pump. Two meshing gears force the fluid through a discharge port and tubing to the hydraulics motor which reacts.

Valves—Valves control system pressure and flow direction. The most common type consists of a spool that slides back and forth inside a housing that has passages in it. As it moves it blocks or opens the passages, routing the fluid through tubing to and from various hydraulic motors.

Another design is the relief valve that protects the system from excessive pressure. It opens when a specific pressure is reached, allowing the fluid to return to the reservoir.

Cylinder/Motor—The hydraulic cylinders and motors convert pressure and flow into mechanical power for performing work.

A hydraulic motor is quite similar to the pump, except it works in the opposite sense. Operating at pressures up to 3,000 pounds per square inch, gear motors in turf care equipment are commonly used to power hydraulic reel mowers, rotary mowers, spreader and similar drives.

Tubing/Hoses—These connect the hydraulic components to form a system. While pipe and mild steel tubing are commonly used in mobile hydraulic systems, the latter is preferred because it is easily bent, and requires fewer sections and fittings.

Flexible hose is used where a line is subject to movement. Besides simplifying connections, it also helps absorb excess pressure within the system.

Hydrostatic transmission

One of the major applications of hydraulics is the hydrostatic transmission found in all our mowing machines except our larger turf tractors.

The heart of this transmission is its variable displacement pump of piston-type design. By simply moving a foot treadle, the pump's output flow can be varied from zero to a higher rate. The same foot control can change direction of the flow to reverse the rotation of

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the motor. Both pump and motor can be in a single housing, or they can be separated in what is called a split system.

In operation, when the control treadle is near neutral, the transmission is in low range. As the treadle is advanced, the ratio is gradually changed to high range. Thus, when climbing steep grades or doing heavy work, it's important for the operator to ease up on the control, returning the transmission to low range.

With one control for speed and forward and reverse motion, a machine with a hydrostatic transmission is exceptionally simple to operate. In addition, vehicle speed can be varied independent of engine speed, improving maneuverability without affecting the performance of implements such as mowers, sweepers, etc. Another advantage is it can act as a braking system, increasing safety and operator control and reducing brake wear.

Finally, because this transmission is sealed, it can operate in dusty environments, providing long, trouble-free performance with normal maintenance.

In the future there will be even more applications of hydraulic systems, making turf care equipment safer, more versatile and easier to operate. They'll be lighter, too, with the development of smaller systems with increased pressure leading to more compact machines.

Electronic controls incorporated in hydraulic circuits will sense loads and instantly adjust valve or pump action, reducing operating costs.

And new component designs will result in even quieter systems for improved operator comfort and unobtrusive operation.

Troubleshooting

One of the best rules to follow when faced with a hydraulic problem is, don't assume anything.

Here's just one example of what we mean: because a failure anywhere in a hydraulic system always shows up first at the working end, the assumption too often has been that the cylinder or motor is malfunctioning. One of them may be at fault but so could a variety of other components, including some that are not related to the system itself.

Instead of the expense and downtime in changing a hydraulic cylinder, setting the engine at the proper rpm is all that may be needed.

In this example, like in others we could cite, the assumption compounds the problem since the system won't operate any better than it did before the replacement. And this means more time and money will be lost.

So, when faced with a hydraulics problem, the best place to begin is at the beginning, setting all assumptions aside.

For our purpose here the beginning is understanding system components, what can happen to them and how to maintain them. This is basic preventive maintenance. It's easily the simplest and lest expensive way to keep your equipment productive.

Reservoir—The reservoir does more than hold hydraulic fluid. Its walls act as heat exchangers, keeping fluid at an effective working temperature. What's important here is to make certain reservoir walls are free of grass, dirt, etc., since these act as insulation. A heavy buildup could lead to a breakdown of the fluid and suggest failure of various components, easily made but improper assumptions.

Filter—Its job is to remove contaminants, anything foreign to the fluid. Changing the filter as required or needed is the easiest and least expensive preventive maintenance you can perform. You simply spin off the old canister and spin on the new one. Its cost is minimal compared to replacing a valve bank due to excessive wear caused by contaminants.

How do contaminants get in the fluid? Many ways. Not all hydraulic systems are closed so they can be introduced by the ambient air. Since this could happen during manufacturing, it's a good idea to change the filter on a new machine after the first 25 hours of operation. If dusty conditions prevail during operation, you'll want to consult your manual for recommended frequency of change.

Contaminants also can enter inadvertently in other ways. For example, by not using a clean cloth for wiping the dipstick when checking fluid level, lint and dirt particles may be introduced.

Filter design is a science unto itself, with the micron rating carefully selected for a specific system. This means using the exact replacement is critically important.

Why? Consider the micron method of rating. We can see 40 microns on up. Obviously, a 10 micron filter is extremely fine, the size of one particle of talcum powder. If a rating of 10 is recommended and a 30 is used, you can expect a problem in the system at some time in the future. The 30 simply won't do the filtering job that's required.

Generally, the filter should be changed every 250 hours of operation. But the best advice is to follow the manual, and use the replacement available from the company that made the equipment.

Hydraulic Fluid—Unlike engine oil that receives contaminants from combustion, hydraulic fluid can last a long time if kept clean and not overheated.

Because of advances in oil and seal technology, engine oils are more commonly acceptable for hydraulic use, with an SAE rating of SE or SF 10-30 performing well in many systems. Please note, however, that a straight weight oil, normally a 20 (or a 30 in hotter climates), should be used in the EATO hydrostatic transmissions—not a multigrade.

Watch for leakage. It could be caused by higher pressures due to water within the system. It shouldn't be there.

If you want to know what is going on inside a hydraulic system (or engine), for a nominal charge (sometimes it's free) you can have the oil analyzed at periodic intervals. Several major oil companies now offer an analysis that documents levels of various substances within the oil. For example, traces of valve metal and contaminants increasing with each analysis would indicate a valve problem ahead as well as the need for more frequent filter replacement. All you do is send a small vial of the used oil to a com-

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pany offering the service. They take it from there. The thing to remember is to do it at the same hour interval so the data shows a progression.

As we mentioned earlier, unless broken down from overheating, oil will last for a long time. This in mind, the "filter buggy" was developed. This portable unit is brought to the machine to clean the oil. It typically uses a 3 micron filter which results in oil that is cleaner than when new. (Note: using a filter finer than recommended in your system will restrict flow to the point where it will bypass the filter, clearly undesirable.)

Pump—Remember, flow is related to the speed of the hydraulically operated device. Pressure is related to the force. Keeping these facts in mind makes trouble shooting easier. For example, if the speed of a lift is too slow, the problem may be in the pump and not in the cylinder.

Pumps, life valves, are subject to wear from contaminants in the oil. A substance so fine as to feel slippery can cause damage.

Lines—Whether flexible or rigid, always replace a line with its exact equivalent. Lines are engineered for specific flow and pressure. Installing one that is larger or smaller than the original changes the system—and changes the action so that a hydraulically powered component will, for example drop rapidly rather than ease down. Too small a line will slow motion. And a line with a thinner wall may rupture.

A common problem source with lines is vibration that loosens connections. When tightening, use this rule: make the connection finger tight, then tighten ⅛th turn more or one flat of the nut. That's all. Keep in mind, the threads of a fitting don't make the seal; rather, it's the taper of the flare and adapter, the ferrule of compression fittings or the O-ring that does the sealing. Overtightening can damage the seat, ferrule or O-ring, or break the ends of tubing or hoses, causing leakage. Speaking of leaks, remember if oil can get out, dirt can get in.

Obviously, you'll want to keep an eye out for chafing of flexible hoses. They should be properly routed and secured at all times.

Valving—Valves are fine instruments, machined to extremely close tolerances, which is why contaminants can be so damaging. Remember, like any fluid, oil will follow that path of least resistance. This means that slight wear from minute particles in the oil will become progressively greater, altering performance.

All our hydraulic systems have relief valves, safety devices engineered to open with maximum designed pressure is reached. The rule to follow is never, never tamper with them. Here's the reason: the entire system is designed to operate at a specific pressure. For example, a gang arm of our HF-15 mowing tractor operates at from 400 to 800 psi. Shimming up the relief valve to make arm operation faster could increase pressure by as much as 700 percent, but not increase speed, leading to pump, fitting or other component failure. Keep pressure at the recommended level by using a gauge whenever making adjustments in this area.

If you are really puzzled over valve performance, don't hestiate to call your distributor. Getting the answer to a few questions can avoid considerable damage, expense and time.

Motors & Cylinders—Like a pump, a hydraulic motor is subject to less wear because it runs intermittently. Contaminants, however, will take their toll by damaging closely meshing aprts.

Cylinders are more vulnerable, with rods exposed to dirt when they stroke out during operation. They should regularly be cleaned to keep contaminants out of the seal area. Often chemicals used on turf will deteriorate protective seals and rod wipers.

Inspection—Here's where a few moments can substantially reduce downtime and costs, if the operator knows what to look and listen for and follows a set routine.

For example, the dipstick can reveal more than fluid level. Whitish oil may indicate that water or air has gotten into the system. A gritty feel is a clear danger sign of contaminants. Dirt that has collected around fittings can mean a leak and call for a slight tightening of a fixture. Fresh oil spots where the machine is parked pinpoint problem areas. During washdown, hoses should be checked for chafing, bends or crimps.

On the audible side, pumps emit a metallic rattling sound that can indicate air is in the system. But this can also mean a coupling is loose. Chatter when the hydraulics are actuating a component can also indicate air—or linkage binding.

Some sounds are normal, however. A high-pitched squeal when activating a gang arm may merely indicate a relief valve has opened. The moan of a hydrostatic transmission is not unordinary.

Trouble-shooting—This is an area that is difficult to chart. It really begins with knowledge of hydraulics and builds through experience.

Most trouble-shooting should start with the process of elimination. When a system malfunctions, look for the obvious. For example, when a reel mower stops, it may be nothing more than a golf spike caught in the blades. Turn off the system and spin the reels by hand to dislodge the spike or whatever else might be caught.

But if the solution isn't the obvious, then move further into the process of elimination. In a system with more than one pump, try switching the lines. If the problem persists, you'll know it's not in the pump. Similarly, other lines can be switched to check valve banks and cylinders or motors. (Take care to clean connections before making the switch to avoid contamination.) Naturally, all components should be inspected for leakage, chaffing, etc. Keep in mind that oil thins when hot, finding wear passages and decreasing working pressure.

One helpful device is an instrument that measures flow and temperature between components. Learning to use it could save considerable time and unnecessary expense.

But most of all remember that hydraulic systems, indispensable to transmitting power, are highly reliable and virtually maintenance free—especially when they are understood and properly looked after. **WTT**