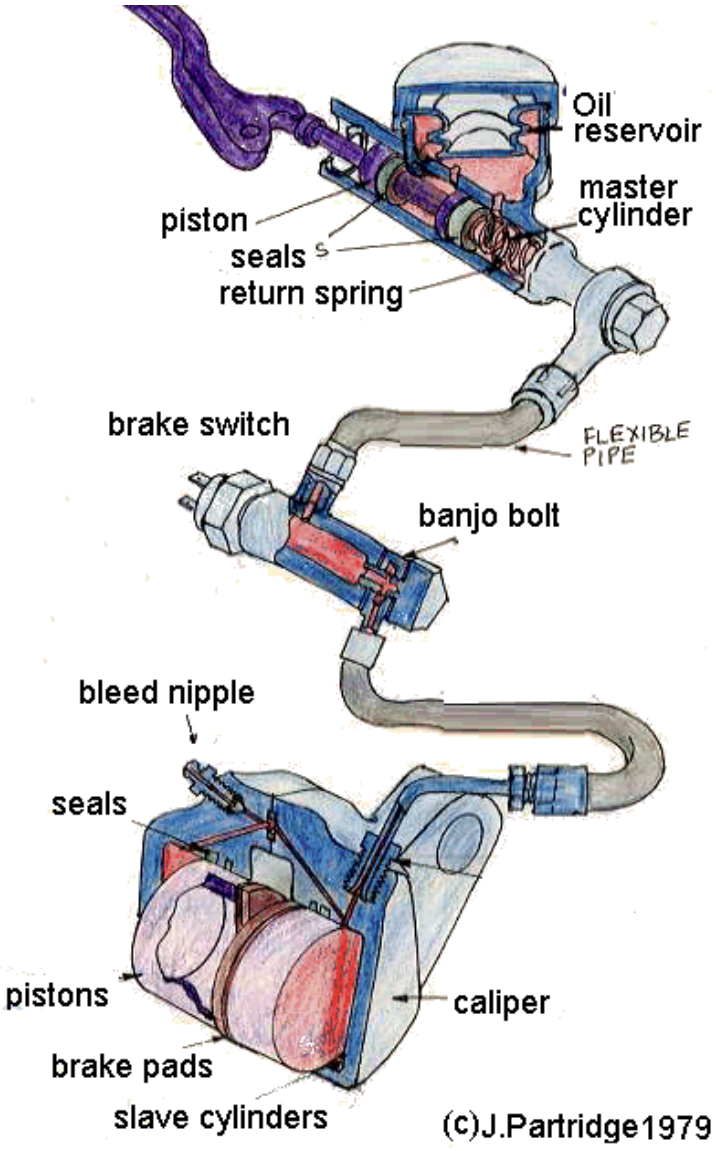
Hydraulic systems.

Liquid cannot be compressed, but it can flow easily. This makes it ideal for transferring forces via pipes. Another advantage is that a force on a small piston at the handlebar can exert a much higher force on a larger piston at the brake calliper using the same hydraulic pressure throughout the system.

The disk may be buckled or worn too thin to be safe. Disc brakes are less likely to suffer corrosion compared to drums, but the repair is more delicate. There are a few cable operated disc brakes, but these are often beyond economic repair. If one is fitted, take time and be careful how it is cleaned and repaired and ensure the cable slides freely.



Rebuilding a master cylinder.

While on the bike, slacken all external screws, starting with the small cap screws. Remove from the bike and disassemble of a clean sheet of newspaper. If a plastic reservoir, then this can often be removed with a little sensible force, if not retained by any observable retaining device. The main areas to check are the state of the rubber piston seals and the very small, fine hole in the body. Then carefully inspect the state of the bore in the body. Removal of the circlip gives access to these components. The fluid is best discarded and replaced with new brake fluid. DOT 3 or 4 Car brake fluid will be quite adequate unless otherwise specified by the manufacturer.

The main problem is corrosion. In most cases, this can be carefully removed and the components cleaned with soft cloth and an old toothbrush. Do not scratch the rubber components, the bore and ensure the very small hole next to the larger hole in the base of the reservoir is clear. Use a strand from a steel wire brush to clean it. Do not damage any of the rubber seals, leave them in place on their shafts unless using a repair kit with new seals. As this demands a high level of cleanliness, a kitchen towel will help the final cleaning of components.

The rebuilding of the brake calliper is similar, except that removal of the pistons is very awkward. If a working system, each piston can be pumped out almost all the way, then retained with a clamp or block of wood while the stiffer piston is pumped out. Where the piston cannot be pumped out, then a strong pair of pliers must be used to carefully twist the piston in its calliper without damaging the surface. With practice, the piston is pulled and twisted out. If an airline is available then this can pump out pistons, using the block of wood to prevent them blowing out fully. Always use eye protection with air lines. It is sometimes possible to use a pushbike pump with a nozzle to apply pressure to the system, but a rubber seal will be needed to maintain pressure.

Warning, some pistons are now made from a Bakelite type of rigid plastic which can crack easily, so do not tease out with pliers unless absolutely necessary.

Once removed, the pistons can be gently cleaned with very fine, well worn wet and dry abrasive paper. The caliper will have an outer rubber seal and the inner main piston seal which can be very carefully removed with a small blunt screwdriver or a wooden or plastic toothpick. The calliper body and components can then be cleaned fully.

A banjo bolt is a hollow bolt which fits into a banjo shaped pipe connection. This is found in many bike hydraulic systems. The joint is sealed with small copper washers. These are normally replaced if suspect, but all copper washers can be annealed. Simply hook the copper washers on a piece of wire and hold over a flame until the copper glows red, then plunge into cold water. The copper will be annealed and soft. If any corrosion, then lightly clean before use. Annealed copper, being soft, will take up the shape and prevent leaks. Aluminium washers are now becoming popular. To anneal aluminium, at a much lower temperature, rub soap on the alloy, when heated until the soap begins to turn brown, plunge into cold water.

Initially, when refitting back onto the bike, there will be a large amount of air in the system. This can cause problems bleeding the system, but there are many ways around this. The simplest is to simply remove the master cylinder banjo bolt and open the calliper bleed nipple, then pour brake fluid into the pipe until most of the air is expelled, then close the bleed nipple. Then prime the master cylinder. Fill the master cylinder, and with a finger over the outlet hole, pump the master cylinder until oil squirts out past the light finger pressure. There will be little air left in the system if the master cylinder is connected to the pipe quickly. Then the master cylinder is again pumped, but with the pipe connection just a little loose, so that any air can be expelled. When only oil squirts out, then the banjo bolt can be tightened. The bottom bleed nipple can now be slightly opened and a length of pipe attached, to conduct the pumped brake fluid into a small container, usually another brake fluid bottle. The ideal pipe is the clear pipe used for new battery vent pipes. This is often found discarded in bike shops. The bleeding process is usually pull in the lever, tighten the nipple, allow the lever out; then loosen the bleed nipple and pump again, until all air is expelled from the system. A better way to bleed which has been used by the author for decades is to close the end of the plastic pipe which sits in the bottle, then make a small slit near the end. This slit will act as a simple one way valve, allowing the oil and air out under pressure, but not back when the brake lever is released. Very simple, very effective, very cheap. There will be some very awkward brakes which will not want to be bled easily, so they must be purged with fluid to remove major blockages of air, which can prevent adequate pumping. Some of the worst pipes to bleed are from the handlebar rear brake on scooters to the rear disc calliper.

Cleanliness of the components, especially the master cylinder is important. Although it is common practice to replace all seals, the author has yet to do so, having had no

problems over a few decades of repairing bike and car hydraulic systems. A few repair kits remain in their plastic bags, collecting dust. Cleanliness and a good master cylinder bore are most important. Never let oil get onto the braking material. Check all brakes fully before use. When bleeding brakes in a shop, always protect the customers paint-work because brake fluid can damage paint.

Removing broken threads.

Bleed nipples tend to break on older machines due to rust. Always drench in penetrating oil before trying to undo a suspect bleed nipple. This is often due to loss of the small rubber bleed nipple cap. When a bleed nipple shears off, there is a perfectly central hole to take a drill. Use this very carefully so the drill does not go full depth into the aluminium calliper body. There are excellent left handed drill bits available from the big red American tool van and these will tend to turn the stubborn threads out of sheared stud, bolt and other holes.

The common range of stud extractors have a poor history of successes, and it is often better to drill accurately into a broken thread, to just touch the outside of the thread itself. This will then allow a sharp point to pick out the steel thread from the aluminium. It is tricky, it needs accurate drilling, but it works without damaging the main component. Start with a small drill, and get it accurately aligned before drilling the larger hole. When a thread is removed, clean it up with an improvised tap. This is a bolt with the same thread, but with hacksaw slits cut in it to help remove any excess corrosion. Use copper grease on new threads. The awkward range of sheared fasteners include exhaust studs, brake bleed nipples, cylinder head studs and fork leg mudguard bolts. These should be targeted with penetrating or releasing oil before being touched. Always replace the small rubber bleed nipple cap, so that water does not corrode the internals of the bleed nipple or it's thread. They are cheap. If in a bike shop, the small red plastic vacuum vent seals which have been discarded from new batteries make good substitutes.

When a threaded hole is beyond repair, it can be given a thread insert. This is in one of two forms. The first is a spiral of stainless steel, a helical coil of profiled wire which fits inside a slightly larger threaded hole with the same pitch as the original, to act as an intermediary thread between both. The other is a more solid piece of metal, again acting in a similar manner but in a larger re-threaded hole. The latter is recommended for spark plugs. The coil thread inserts are often used on spark plugs, but do not so easily transfer cooling heat from the plug to the cylinder head. If problems should occur with either method, use a slightly cooler running spark plug.

In some cases, a bleed nipple replacement can be incorporated into the banjo bolt and is a common aftermarket replacement, allowing the corroded and sheared off bleed nipple to be left in place. Do not be like a very large and popular motorcycle dealer near the author, whose mechanics sent a friends bike out with a badly fitted bolt to seal the broken off bleed nipple in the calliper. It looked even worse than it sounds and the bolt stuck out like a sore thumb. Worse still, the bolt hole was badly tapped with an inappropriate thread size. Not acceptable by any standard and dangerous, yet common practice in large bike shops. I repaired the problem by scrupulously cleaning up the thread, making then fitting a specially prepared, tight fitting mild steel bolt into the new hole with mechanical adhesive then filing it flush. This subsequently allowed tapping a smaller diameter bleed nipple thread into the bolt, cleaning up the base seal taper and fitting a new bleed nipple. In a decent bike shop, a good second hand calliper or a new component would have been the obvious choice.