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PCC St. Michael and All Angels Church,
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Hydraulic Engines and Pipe Organs

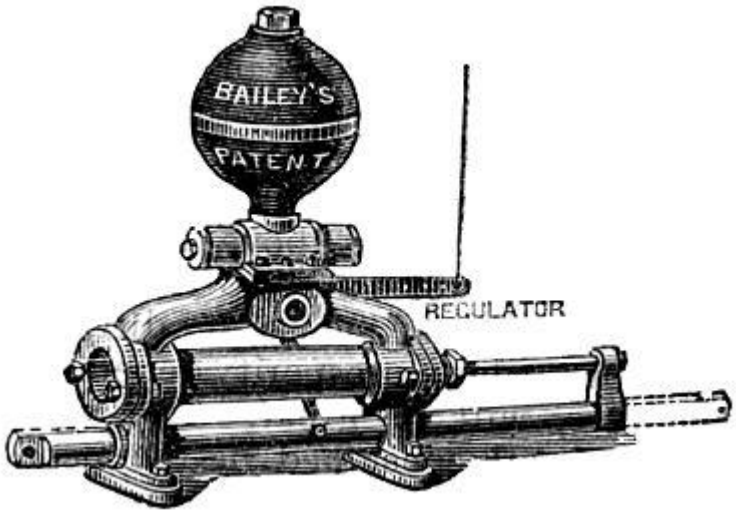
There is some conjecture about the exact date when the organ hydraulic, or water, engine was invented and applied but the first working engine was patented by David Joy, the famous steam engineer and inventor of Joy's Vale gear. This would have been around the mid 1800's and was in response to his having to pump an organ whilst visiting relatives. His background in steam engine engineering is reflected in the design and the core of the design remained unaltered in all subsequent forms brought out by various manufacturers.

Published June 1st 1857 by the inventor David Joy

Description of a New Hydraulic Engine

The form of hydraulic engine, which is the subject of the present paper, was originated by the requirement of a motive power for the special purpose of blowing the bellows of a large organ, and was not at the time intended to be applied beyond the single case for which it was designed by the writer. Several conditions were requisite in the arrangements: first, that the power should be supplied from some constantly accessible source; this condition at once pointed to water pressure as the only available power, and resolved the question into a hydraulic engine, required not only to give out a reciprocating motion, but to be capable of regulation down to the slowest possible speed without having a dead point; at the same time to be perfectly free from shocks due to water in motion at high pressure.

Within a short period other manufacturers came up with their own designs across the world and one of these was the Bailey Patent Water Engine installed at Moccas. W.H. Bailey & Co Ltd. of Salford were advertising themselves as hydraulic engineers by 1879 and presumably the engine was installed around this time.



Advert from 1880

The Engine of St. Michael and All Angels, Moccas

Above is an illustration of their horizontal engine and the similarity between this and engine at Moccas is clear. As with many installations the engine at Moccas directly replaced manual operation of the feeders via the original blowing handle. At some point in the engines history the first installation was altered, possibly due to wear of the original timber lever and linkages. Then, with the advent of electricity in the church, the engine was made redundant and an electric blower was installed. The engine itself remained in place but clearly suffered some damage along the way combined with natural deterioration from the damp in the chamber. An attempt had been made to resurrect the engine but it is not clear by whom or when. The only clue was a liberal covering of Hammer finish paint to the cast iron parts of the unit, which suggests within the last forty years or so. Unfortunately this intervention was not very well executed, no doubt due to limited resources and funds, and the consequences became evident during the restoration of the engine.

Due to its vertical position, and the use of a heavy iron guide rod extending down well beyond the main casting and floor level at the lowest point of the stroke, a hole had to be bored through the stone floor and a socket of soil excavated to allow the penetration of the guide rod. Over the years this hole filled with damp soil and dirt and with the rod in the lowest position this meant corrosion set in. The rod itself runs through two guides bored in the main casting but without any form of bushing hence it was not only corroded at its lower extremity but also stuck fast in the casting.

At some point the throttle valve, necessary to control the speed of the engine, must have seized and forcibly trying to move this had opened a large fracture in the brass casting. An attempt had been made to fill and cover this with plumbers solder, straighten the valve rod and repair the quite delicate rotary valve within the body hence it was beyond salvage. The elbow joint, carrying the pressure vessel to stop water hammer, was of iron pipe and hence corroded beyond use, as was the exhaust joint. Mysteriously there was no sign of any linkage to the reservoir top for the throttle control when the engine was removed and a miscellaneous pressure gage was discovered buried in the accumulated dirt on the floor.

During dismantling cylinder studs, of wrought iron, simply sheared off in the main casting and the final result was a large collection of parts in various states either beyond repair or in need of severe attention.

The Restoration

At this point it should be qualified that strict restoration is not always possible with a machine where there has been a lot of decay, breakage and intervention. The purpose of the project was to make the engine function reliably and keep the repairs and restoration as close to the original as possible whilst ensuring that the work would be more resistant to decay and so preserve the engine working for a longer period.

Having dismantled the engine into all its various components the main casting was tackled first. The mounting feet were simply in the rough cast condition, the valve box seat corroded and pitted and the guide bores, for the main guide rod, also badly pitted. So the first stage was to machine one true, flat surface from which all others could be referenced. The cylinder port was the largest originally machined area so this was used as the reference to machine both feet flat. The exhaust and intake surfaces, again in the rough cast condition and, in the case of the exhaust, having the broken end of the brass connection pipe stuck fast, were machined out and flat ready for new fittings. Then the cylinder port itself could be skimmed flat and finally the bore was aligned on the milling machine to bore out the guides for the guide bar and any broken cylinder studs.

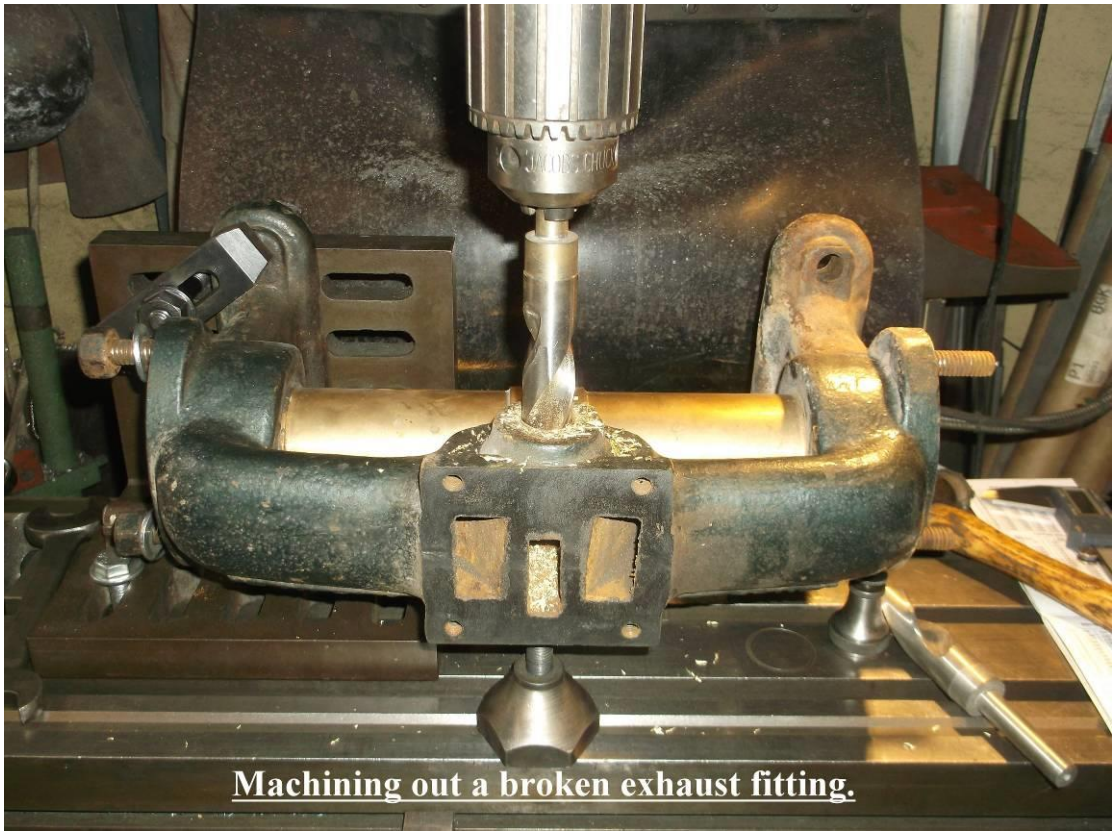
The next port of call was to remove the previous paint work and clean and strip back all the parts to bare metal so that they could be examined in greater detail. The first stage in this process was to boil all the items in strong soda and steam clean them. This process removes paint, oil and grease whilst leaving the items untouched. The cast iron parts were blast cleaned with fine aluminium oxide having protected any vulnerable surfaces. In the case of the main casting this meant protecting the bronze cylinder barrel. This item was machined to a close fit in the cast iron casting when first made and then fixed and sealed in position by peening out the ends of the cylinder. This meant it could not be removed and so the outer surface was heavily masked against the abrasive and the ends of the cylinder plugged to protect the bore.

The Hydraulic Engine from Moccas

Cylinder and combined mount and manifold stripped down and mounted up for re-machining the mount feet.

Machining the feet flat to provide an accurate datum on one plane.

Skimming the cylinder ports to the same plane as the feet.



Machining out a broken exhaust fitting.

The old guide bar was to be replaced with a pattern made guide in corrosion resistant stainless steel so the casting guide holes needed bushing. The casting was set up in line with the axis of the milling machine and the original holes bored to suit new sintered bronze bushes.

Post cleaning back to bare metal the main casting was then repainted in a Victorian green having first been primed with etch primer and then finally the paint had a coating of lacquer. A cylinder hone was then machined down in hardwood and the cylinder honed to remove minor corrosion and polish the bore.

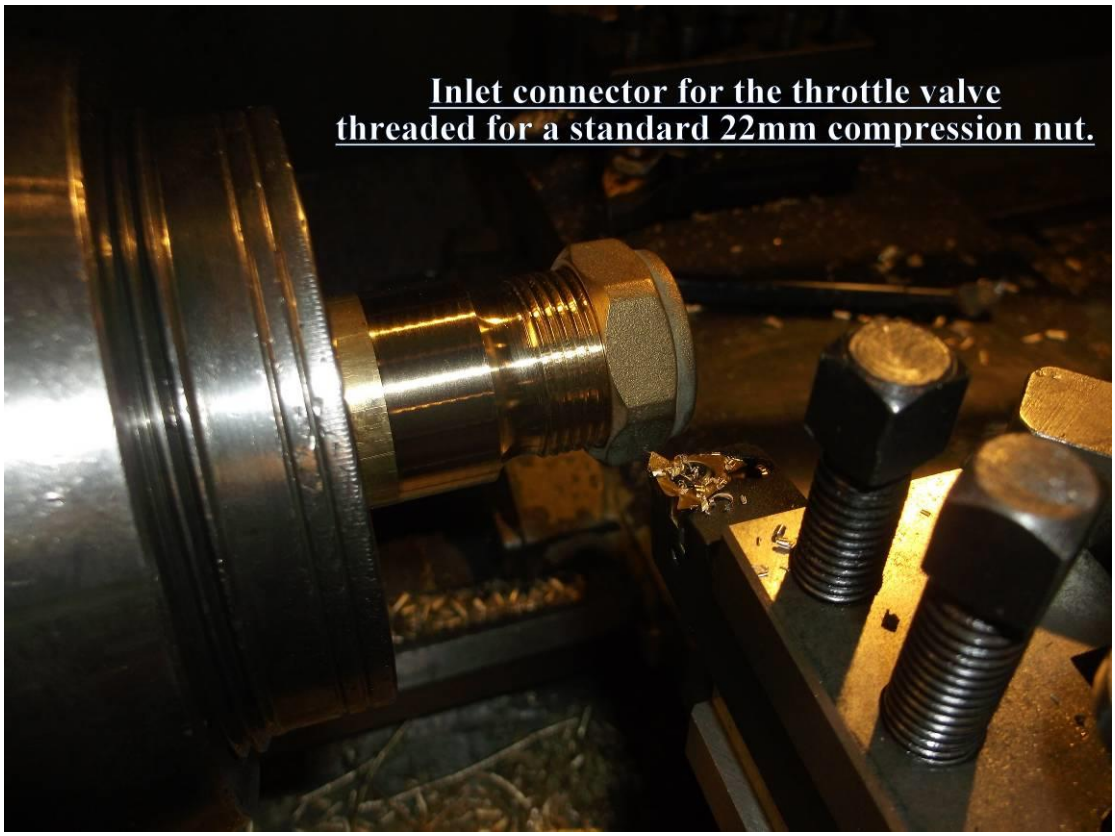
Turning down the honing tool for the cylinder clean up.

Cylinder studs, nuts and those for the valve chest were all remade in stainless steel. The valve plate and any mating machined surfaces were all remachined flat and true.

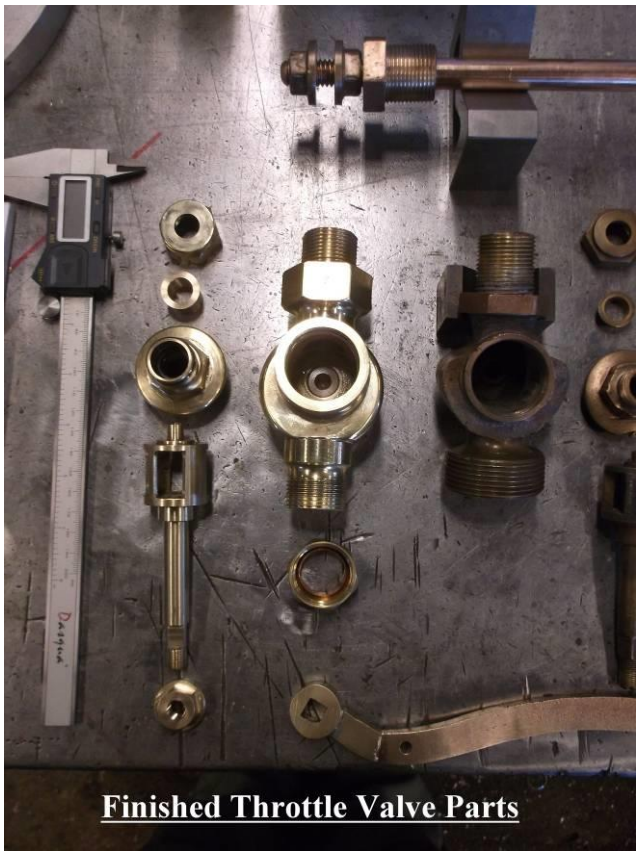
Then came the manufacture of the new throttle valve. The original was a cast item of lantern type but clearly casting a new one would be out of the question so a way of fabricating the new valve as close to the original had to be the solution.

The fabrication required eight different items all machined from solid brass.


Throttle valve cap, screwed into the main body to mount,
being machined for a hex spanner.


Inlet connector for the throttle valve
threaded for a standard 22mm compression nut.

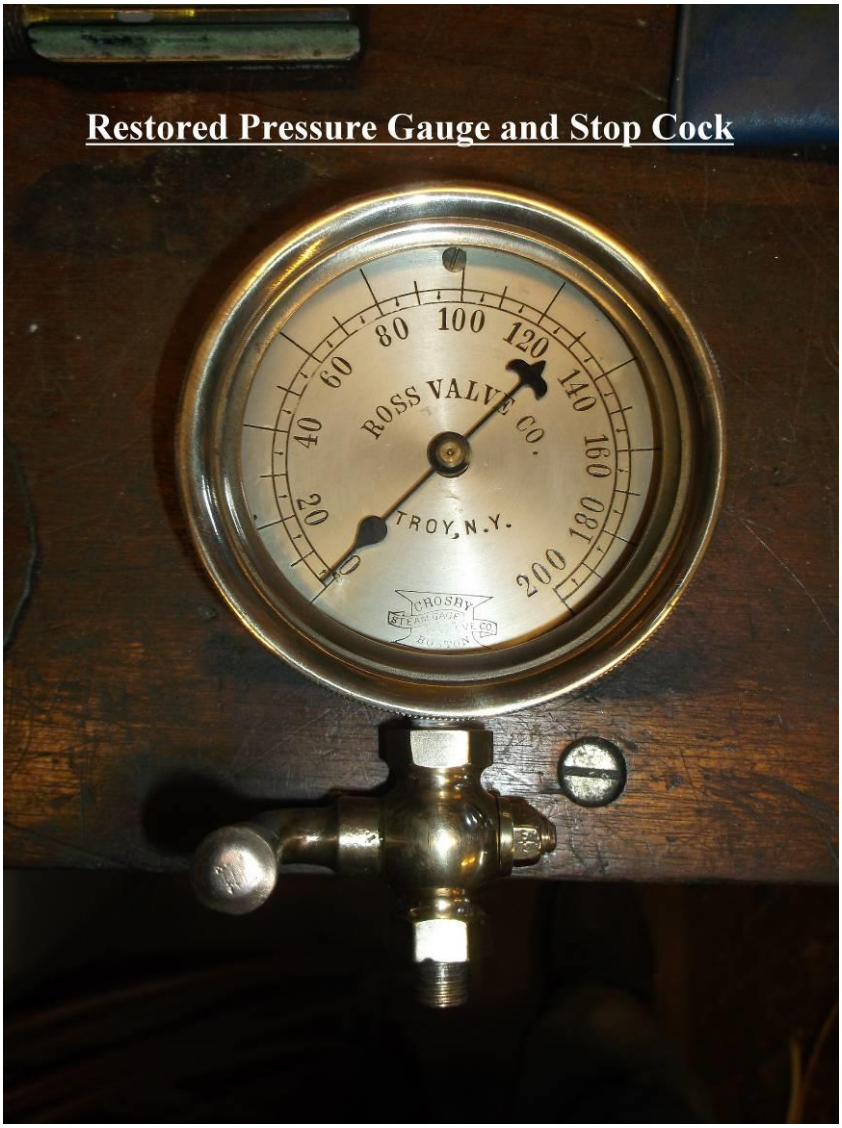
The four components of the valve body were then silver soldered together before final boring of the through water passages.



The control arm for the original valve had also been broken and badly repaired with plates and soft solder so this was repaired with new sections machined and silver brazed to the salvaged arm.

A new brass elbow was machined and brazed for the pressure vessel……

…and the pressure gage and stop cock were restored.



All new gaskets were manufactured in cork-butyl composite, new leather cup washers obtain for the main piston and leather sealing washers made for all the fittings.

At various stages the restored or remanufactured parts were fitted back together to ensure the fit and relation of everything was right.

Ultimately everything on the engine was restored or remanufactured to ensure the final result would work, work reliably and be impervious to environmental influences.

The original oak mounting was damaged and rotten so part of one of the members was cut out and new oak let in.

Once assembled and tested the new water re-circulating system was manufactured along with the general organ control system.

Conclusion

In the whole of the United Kingdom we know of only four locations where engines have been restored and this mainly because we have restored them. In the late Victorian early Edwardian period there were hydraulic engines throughout the country replacing hand blowing mechanisms but the pace of change during this period was fast and hence the advent of electricity and greater demands on water supplies spelled their demise. During the 1950's and 60's the majority of these engines were removed, scrapped and replaced with electric blowers often providing a much needed boost to the wages of organ builders by their scrap value. We have restored engines by Watkins & Watson Ltd, at Union Chapel Islington and Theatre Soar Merthyr Tydfil, and one obscure engine, of more basic design and unknown manufacture, at Averham parish church. All these engines represent the few relics of a period in organ building long gone but Moccas is the only original engine from the very start of their use in pipe organs.