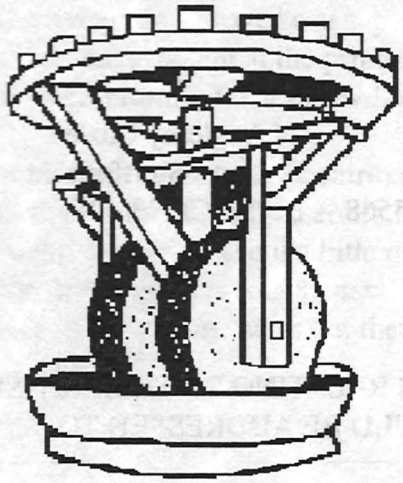
ROYAL
GUNPOWDER
MILLS
WALTHAM ABBEY

'TOUCHPAPER'©
Published by RGM(WA) Friends Association
Printed by PRONTAPRINT Bishop's Stortford

Touchpaper

The Newsletter of the
ROYAL GUNPOWDER MILLS WALTHAM ABBEY

FRIENDS ASSOCIATION



SEPTEMBER
2004

OFFICERS OF THE FRIENDS ASSOCIATION

Chairman:
John Wright — 1 Albury Ride, Cheshunt, Herts EN8 8XE
tel: 01992 624210

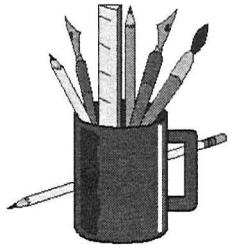
Secretary:
Richard Penfold — 10 Thaxted Way, Waltham Abbey, Essex EN9 1LQ
tel: 01992 712623

Treasurer:
Norman Paul — 24 Anglesey Close, Bishop's Stortford, Herts CM23 4PE
tel: 01279 465568

ALL ENQUIRIES RELATING TO THIS NEWSLETTER SHOULD BE ADDRESSED TO :

Norman Paul
Touchpaper Editor
24 Anglesey Close
Bishop's Stortford
Herts CM23 4PE
tel/fax: 01279 465568
e-mail: NPAUL24@aol.com

PLEASE NOTE: Deadline date for submissions to the next issue is 15th November 2004



EDITORIAL

First off, an apology for the poor reproduction of photographs in the last issue; as so many of you have been at pains to tell me. This was due to an equipment problem at the printers, which has been sorted and I have been promised that this will not happen again.

This issue sees a plethora of technical contributions; I have been quite overwhelmed with them. Sadly there is little in the way of personal items so this issue may seem a little out of balance. Perhaps you can help to redress this for the next issue? With nearly 400 members there must be some news out there.

Norman Paul

P.S. Haven't had time to proof read this issue properly - but no doubt I will be informed of any mistakes.

CHAIRMAN'S CHAT

Welcome to the September issue of Touchpaper.

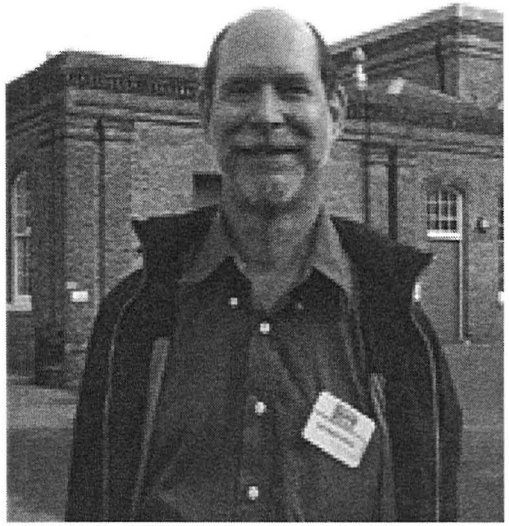
The number of visitors to the site have increased slightly this year compared with last year but is still well short of what is needed if the site is to develop further. The main difficulty in attracting more visitors appears to be the need for substantially more advertising which, at this stage, the Company cannot afford. So please encourage your friends and neighbours to visit; even if they have been before there are many new things to see.

We rely very heavily on volunteers to help in running the site so if any of you can spare the odd weekend day it will help to relieve the burden on those few who already provide the much needed assistance. It's not an onerous task and even one day every month or so would be appreciated.

This applies also to the Friends Working Parties - Wednesday and Fridays where we have, at present, only a small band of regulars. We hope to start some significant projects during the closed period (October to April) and more input would be most welcome.

John Wright

A NEW MEMBER OF STAFF



A warm welcome to Ian MacFarlane who joined the Company in July.

Ian originally came from Toronto, Canada but on marrying an English girl came here to live. His background was in electronics and computers and his knowledge has been invaluable in the general office work. In addition, as all our hard-pressed staff do, he also does anything else that is needed.

Initially this is a seasonal appointment but there is the possibility that a more permanent position may be possible. We certainly hope so!

RAILWAY NEWS July 2004

July, as every month, has been busy on the Railway. The 14th saw the visit of Major John Poynze, the Railway Inspector (retired) to advise us on the quality of the work we are doing, and to give us pointers (no pun intended) on how to continue with the work of building the railway and get it passed for passenger carrying.

I must say, that compared with most Health & Safety personnel I have dealt with in the past, he was most pleasant, helpful and constructive.

We have for some time now, been expecting more low loader wagons from Bishopton, which we hoped to convert to passenger coaches, but there appears to be a problem at the Bishopton end and there is now a question mark over these items. Lets keep our fingers crossed and hope the problem is resolved soon.

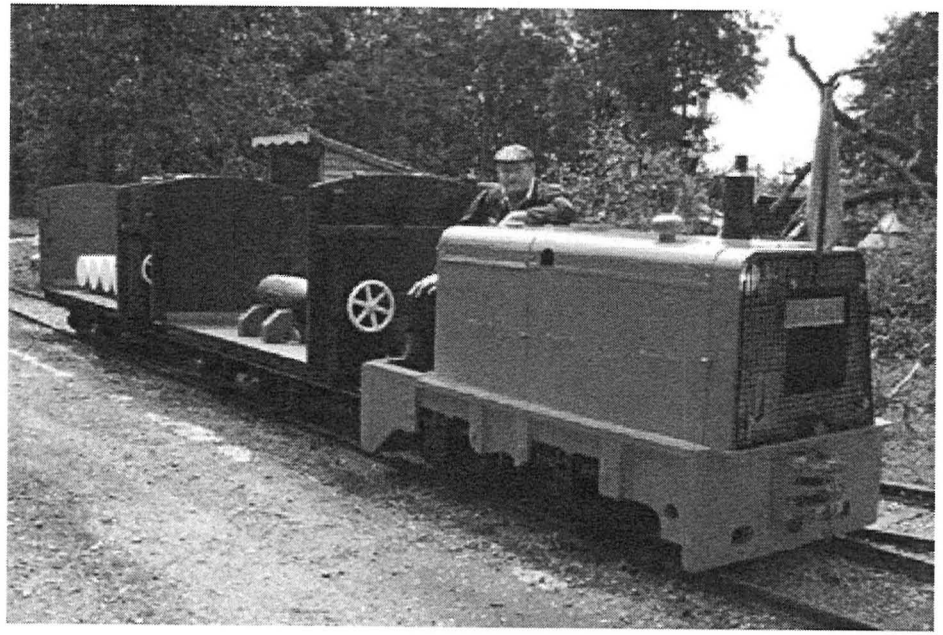
We now have 254M (277yards to the non metric amongst you) of track laid, leaving a further 550M (601yards) still to go. However, of the 254M, some60M is un-useable as it hasn't been ballasted yet.

On the question of ballast, does any reader know a farmer or builder who might lend on long term loan or donate outright, a small dumper truck or mini digger? Shovelling and wheel barrowing 20 tons or more of ballast, is getting a bit too much like hard work for all us old fogies.

The Saturday & Sunday demonstration runs of the loco & two ammunition wagons is going down a treat with the Land Train visitors and we have had a fair bit of feed back from visitors, which we find most heartening.

The photo shows me driving train on Sunday 18th, just after the Land Train had passed.

John Wilson



1856 Hydraulic Press - Waterwheel

The 1856 Hydraulic Press is a unique surviving example of hydrostatic water pressure to operate a gunpowder press being produced by pumps powered by waterpower in the form of the waterwheel at the side of the pumphouse. Mr. J.Kenneth Major, accompanied by a Friend, recently undertook a survey of the waterwheel to record the technical detail and to determine if possible its origins. Mr. Major is an architect by profession and an eminent industrial archaeologist with a lifelong interest in mills and millwork. He is the author of a standard text on the practice of industrial archaeology- ' Fieldwork in Industrial Archaeology', and has lodged his important collection of mill studies, documentation and photographs with the Mill Archive in Reading (www.millarchive.com). Mr. Major has kindly given permission for the following survey of his findings on the waterwheel to be published in Touchpaper.

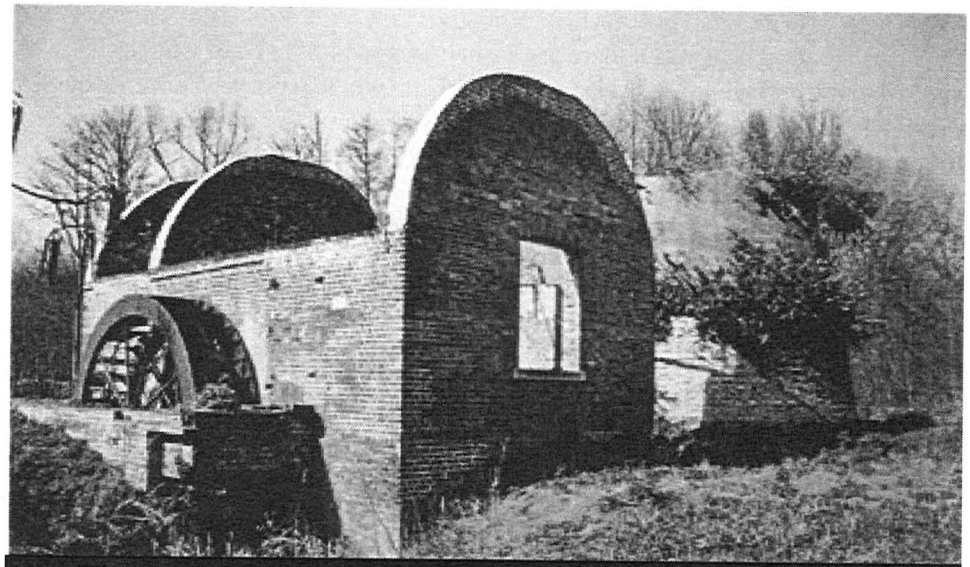
Les Tucker

A WATERWHEEL BY WILLIAM FAIRBAIRN AT THE ROYAL GUNPOWDER MILLS AT WALTHAM ABBEY

Sir William Fairbairn in his book "Mills and Millwork" describes his work in powder mills and in this he states that he worked at the Waltham Abbey Gunpowder Mills. The large waterwheel and grinding pans are described on page 530 of the 4th edition of 1878. The waterwheel that concerns us is not illustrated.

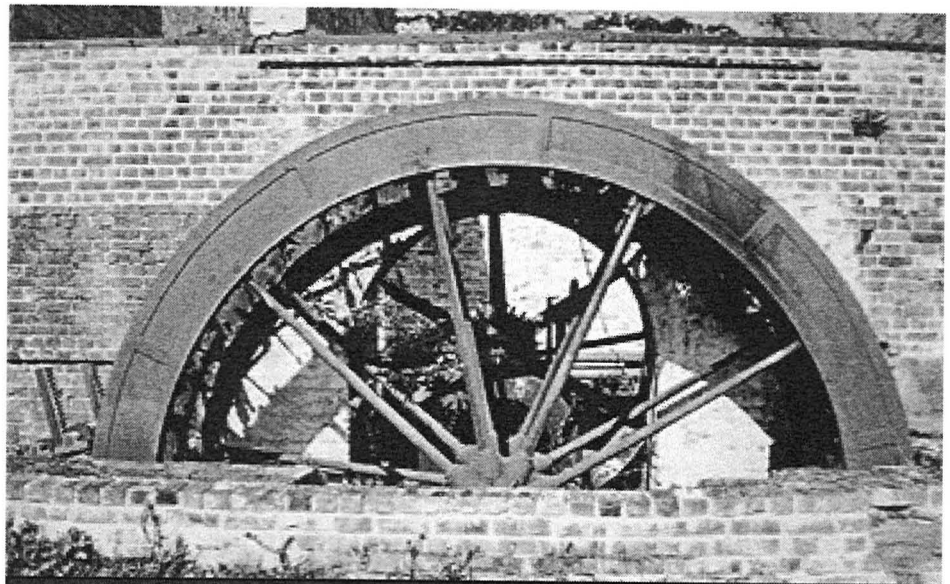
Sir Wlliam Fairbairn was responsible for the waterwheel and machinery in the press house in 1856. At this time he was part of the establishment. He had worked with Prince Albert in the Great Exhibition of 1851, on the Britannia Bridge across the Menai Straits and was commissioned to work at the Royal Gunpowder Mills at Waltham Abbey. Though the castings made by his firm were never signed we must accept that he created the waterwheel, pumps and powder press at Waltham Abbey.

from L to R: The waterwheel and pumphouse, the traverse and the press in the ruins of the presshouse



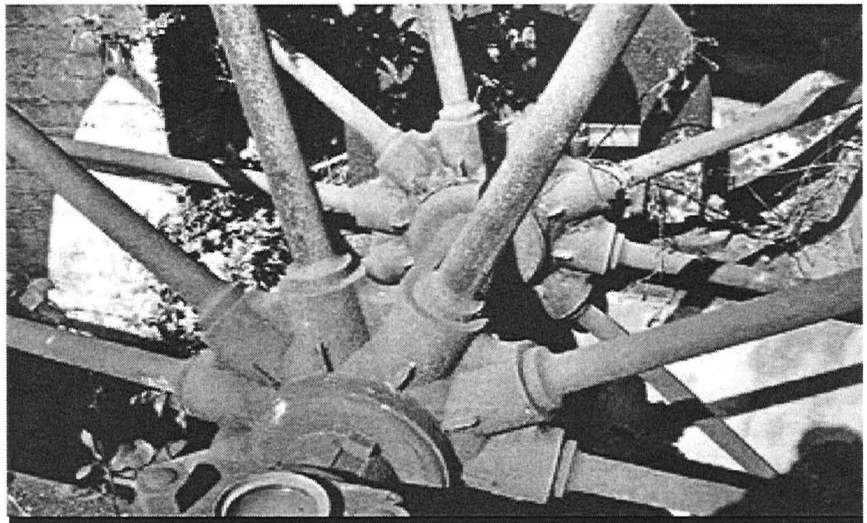
The waterwheel and pumphouse with the traverse beyond

What characterises the Fairbairn waterwheel at Waltham Abbey? The waterwheel is small being only 14ft (4.26m) in diameter and 3ft 2inches (965mm) wide overall. The shrouds are a surprise being 14 inches (355mm) deep. The 40 buckets of this wheel are supported by 'U' shaped castings in the middlem of their spans. This is a variant on the details in "Mills and Millwork."

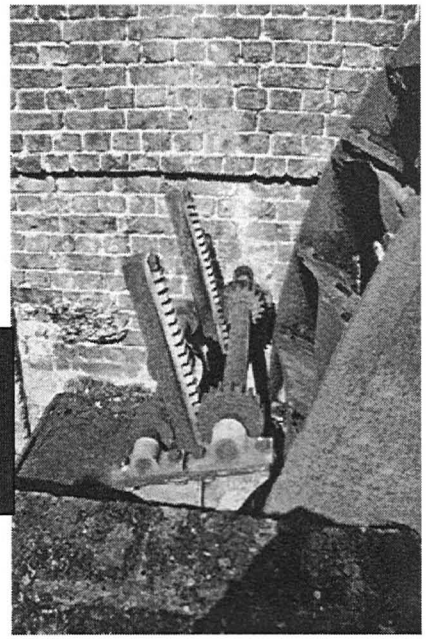


The waterweel with the gears in the pumphouse beyond

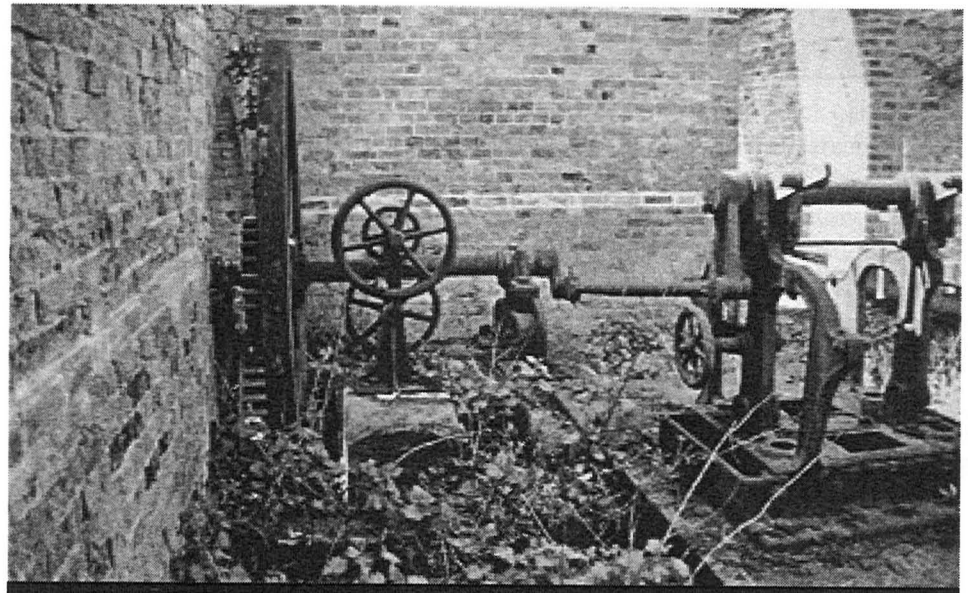
The arms are very heavy and there are 10 in each face of the waterwheel. They are wedged to the hub where each arm is socketed and when in place held by a wedge in a vertical plane. The arms are 1inch (45mm) diameter at the shroud and 2 inches (70mm) at the hub. The cylinder in the hub to receive the arms is 5 inches (130mm) diameter, and that is a single casting.



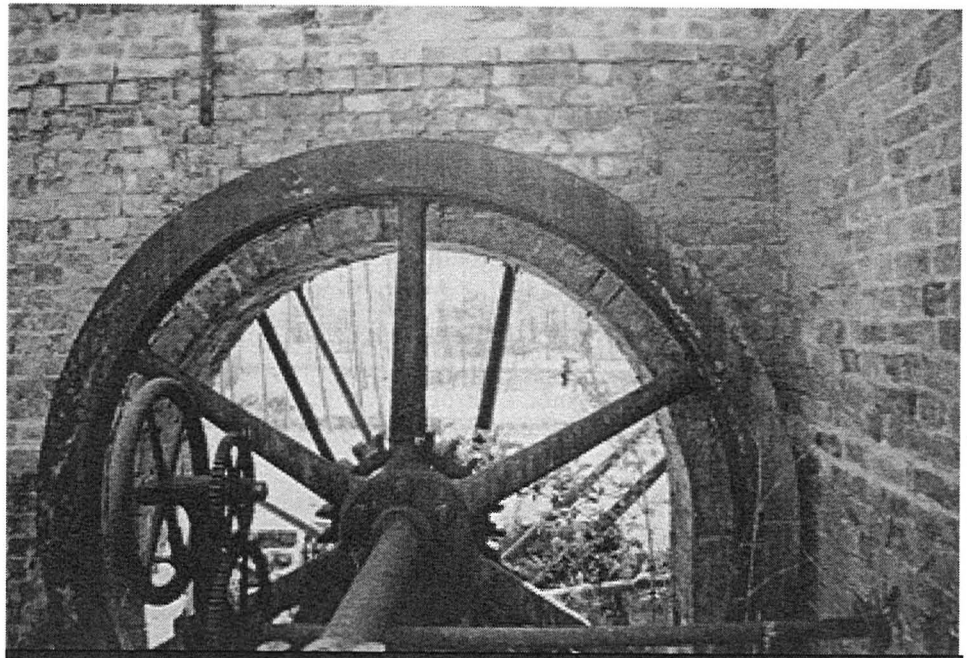
The hub of the waterwheel showing the sockets for the fixing of the arms.These are drawn up tight by wedging.



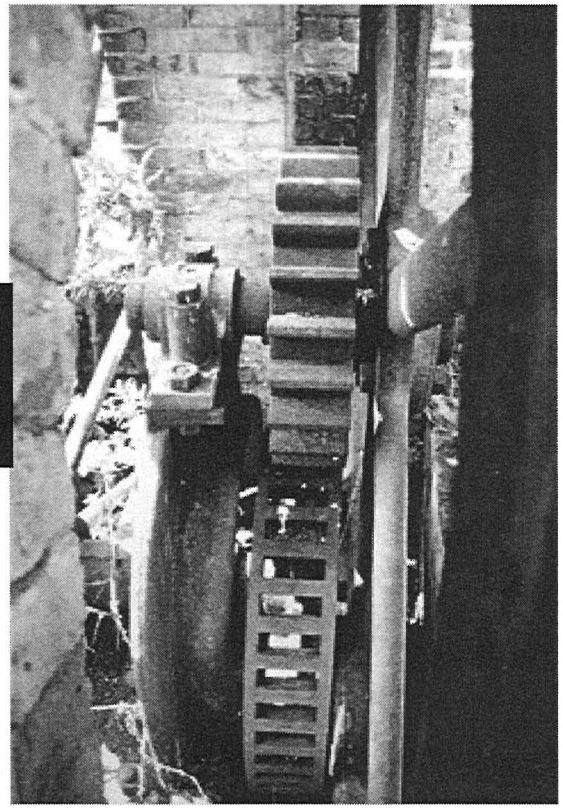
The hatch controls. Note the plummer blocks with the oiling holes set vertically.



The inside of the pumphouse showing the linkage to the pumps from the waterwheel



The flywheel inside the pumphouse looking through to the waterwheel



The drive gears between the waterwheel shaft and the flywheel shaft

Sir William Fairbairn adopted the use of standard screw threads. He used a 2 inch (63mm) hexagonal nut throughout the work, to connect the arms to the shrouds, the plummer block to its base plate and the base plate to the brick supports.
Because there was powder in production Fairbairn used an excess of bronze bearings, in plummer blocks, in the rack and pinnion of the hatch and in other positions. This was over the top as there was a traverse between the pump area and the press house.
An important example of the design skills of the Fairbairn millwrights' office and draughtsmen was the design of the hatch controls. Here the plummer blocks are not supported horizontally but at an angle. The plummer blocks have oiling holes that are vertical!
We can conclude that we have an important and rare example of the Fairbairn waterwheel. Almost no Fairbairn waterwheels exist and this waterwheel of 1856 is a variant on the designs published in "Mills and Millwork" before that date. I hold that it is a Fairbairn waterwheel because of the description in "Mills and Millwork" particularly in the Powder Mills chapter.

J.Kenneth Major

Sir William Fairbairn (1789 - 1874)

William Fairbairn was a Scot who, like so many before, blocked by lack of opportunity at home had come to England to gain experience and progress in his career. He trained as a millwright at the important Percy Main Colliery in Northumberland and from the beginning demonstrated the abilities that were to grow into the astonishing range of talents that we have come to expect of the great Victorian engineers and were eventually to earn him a knighthood.
One of his specialisations was mill machinery and waterwheels and by the age of 28 he had established his own mill machinery manufacturing firm in Manchester, which was to become one of the foremost manufacturers of this machinery in Britain. In addition, his 'Treatise on Mills and Millwork' that he published became a design bible.
Fairbairn's virtuosity was demonstrated in his other activities that encompassed:

Improvements to boiler design, including development of the Lancashire boiler
Advice on and safety testing of the wrought iron tubes of the Britannia Bridge - 1849
Establishing iron shipbuilding firm on the Thames - 1836 and work on the technical development of iron ships, including; Resolution of the problem of effect of iron on ship's compass bearings, Analysis of the behaviour of iron ship hulls in water leading to significant improvements in design
Early advocacy of the advantages of wrought iron in constructional use
Locomotive construction
Invention of a riveting machine

In *The Engineer's* obituary on Fairbairn it was said

> *"Fairbairn's forte lay in Millwright work. It is not too much to say that he revolutionised the art of making mills, whether for grinding wheat or spinning cotton.*
> *He abolished the millwright and introduced the mechanical engineer."*

First Smeaton then Fairbairn could be regarded as the two most influential improvers of water wheel design to produce increased efficiency and power. Prior to Mr. Major's survey it was thought that only three Fairbairn wheels had survived in the UK. Mr. Major's validation of the Waltham Abbey wheel therefore makes it the fourth, and adds even more to the historical importance of the 1856 Hydraulic Press and by the same token makes it even more imperative to ensure its preservation.

[After the above was written Mr. Major informed me that a fifth Fairbairn wheel has just been identified - at the Jamieson Heritage Centre, Midleton, Co.Cork, used for powering machinery in a whisky distillery]

Les Tucker

FLAMEPROOF LOCOMOTIVES

I was recently asked "what constitutes a Flameproof Locomotive and were they used at Waltham Abbey".

So what makes a flameproof Loco flameproof? Well to start with, there are three common types of flameproof loco. (1) Fireless steam locos. (2) Diesel. (3) Battery Electric.

A Fireless Steam loco might seem a contradiction in terms, after all, how can you have a steam loco without a fire to make steam? The answer is simple, you replace the boiler with a well insulated pressure vessel that can be filled with steam from a convenient boiler house or steam line.

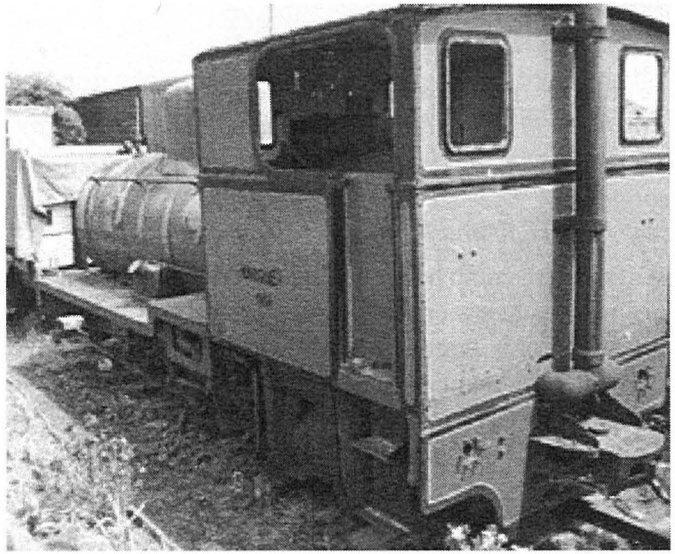
These types of loco were normally 0-4-0 or 0-6-0 wheel configuration, and before the advent of diesel and battery power, the main motive power in hazardous situations such as the Chemical, Papermaking, and indeed the Explosives/Propellants industry.

They were also tried on the early London Underground railway, as an alternative and definitely more healthy option than the conventional steam locos being used at the time. However they did not have the range to work successfully underground, due to the need to top up with steam every few miles.

You may recall the report of a visit to R. N. C. F. Holton Heath in December 03's Touchpaper which mentions "Fowler's Ghosts" which were Fireless Locos, though I have no information on how many there were, or what areas they were used in.

Out of interest, Holton Heath also used Ruston Proctor, ZLH Petrol/Paraffin Locos of the type that Waltham Abbey ran from 1916.

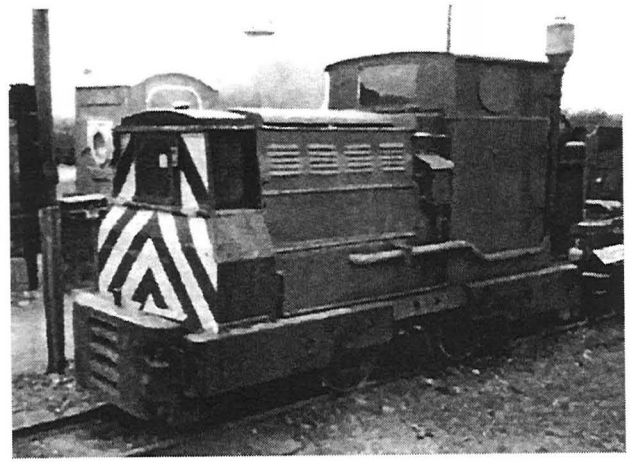
The photo below shows a 2'-6" Gauge Fireless loco "Unique" built by W. A. Bagnall in 1924 for the Bowater paper mill railway at Sittingbourne in Kent, which is now a preserved railway.



Flameproof Diesel Locomotives were and still can be found in the mining industry (what little there is of it) and unlike the Fireless loco, could be built small enough to operate within the confines of a mine.

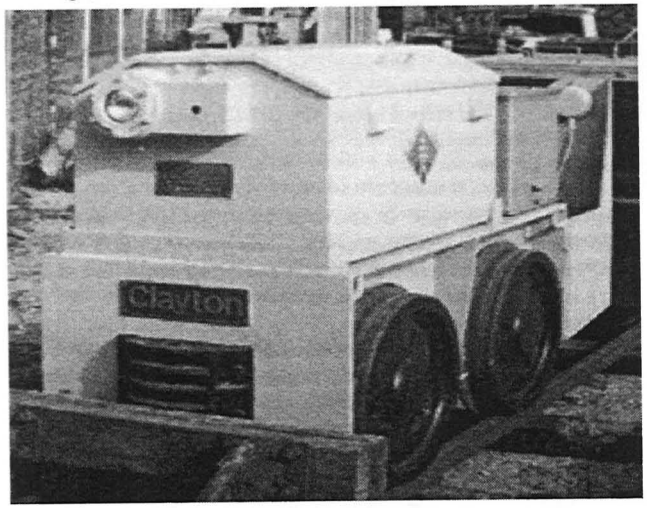
To flameproof a diesel requires a special air filter for the engines air intake, to suppress any backfire that could ignite the miners enemy, firedamp.

The exhaust was a series of stainless steel baffles to dampen any un-burnt fuel, and water could be sprayed into the manifold to cool the exhaust gas. The silencer was a water tank with slag wool filters to clean the exhaust so as not to contaminate the air within the mine. All the electrical equipment, Starter motor, switches, lighting and generator were made air tight so that no sparks could ignite firedamp. Finally the drive wheels were fitted with rubber tyres to prevent metal to metal sparks.



A typical flameproof locomotive supplied to the RAF Bomb Depot at Fauld, was the Ruston Model 44/48, a batch of which were supplied in 1939.

Battery Electric Locos are perhaps the easiest to flameproof, as it is just a matter of making all the electrical systems, including the battery air tight, by sealing them in suitable heavy metal casings, so there is no danger of a spark igniting any combustible material.



Again they can be found most commonly in the mining industry, but were no doubt used in other hazardous industries.

The photo opposite shows a very small Clayton mine loco. Note the sealed front light.

I realise that I haven't answered the original question, "Were flameproof locos used at Waltham Abbey?" Well sorry to disappoint, but the answer is no.

Looking through John Jenkins excellent history of the railway at Waltham Abbey (soon to be reprinted by Robin Parkinson), there is no reference to flameproof locomotives and I can say, without fear of contradiction, that the Ruston Proctor ZLH locos could not be flame proofed as they ran on petrol/paraffin, and it seems unlikely that the later battery locos were flameproof since there appears to be no way for a loco to be driven into a process area on the Waltham Abbey site.

John Wilson

MUZZLE LOADED RIFLED GUNS

As the reader may be aware, we have a Rifled 12.5 inch shell mounted on a railway wagon on our 2'-6" gauge railway. What you may not appreciate is that this shell weights approximately 800 lbs & required a charge of 43 lbs of gunpowder to fire it to a maximum range of 6000 yards.

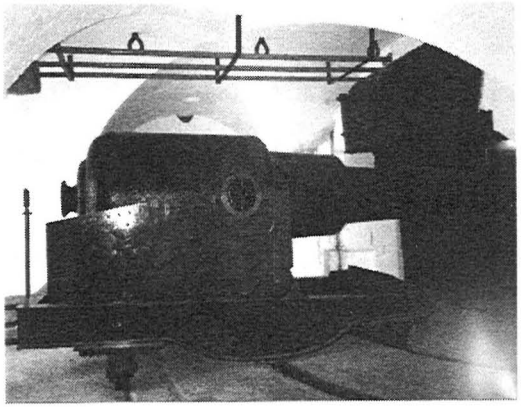
Note the driving studs which engaged the rifling to impart spin to the shell.

By the 1870s these studs were found to be un-necessary and a copper or lead driving band took their place, to engage the rifling.

All though William Armstrong designed & built breach loading rifled guns from the 1850,s, the breach mechanisms proved unreliable and until the 1880,s (when a more reliable breach mechanism was invented) muzzle loading rifled guns were the norm for both land and sea.

The two photos show the type of gun for which this shell was intended.

It is a rifled muzzle loading gun and weighed 38 tons.



A crew of twelve men was required to fire this monster and this type of gun was sited at forts on the coast such as Hurst Castle in Hampshire (where these photos were taken), to guard the western entrance to the Solent.

9", 10" & even 13" guns were built and used both on land and at sea in the new Iron warships that were replacing the traditional wooden ship of Nelsons time.

The Hurst Castle site had ten 12.5 inch and five 10 inch, 18 ton rifled muzzle loading guns.

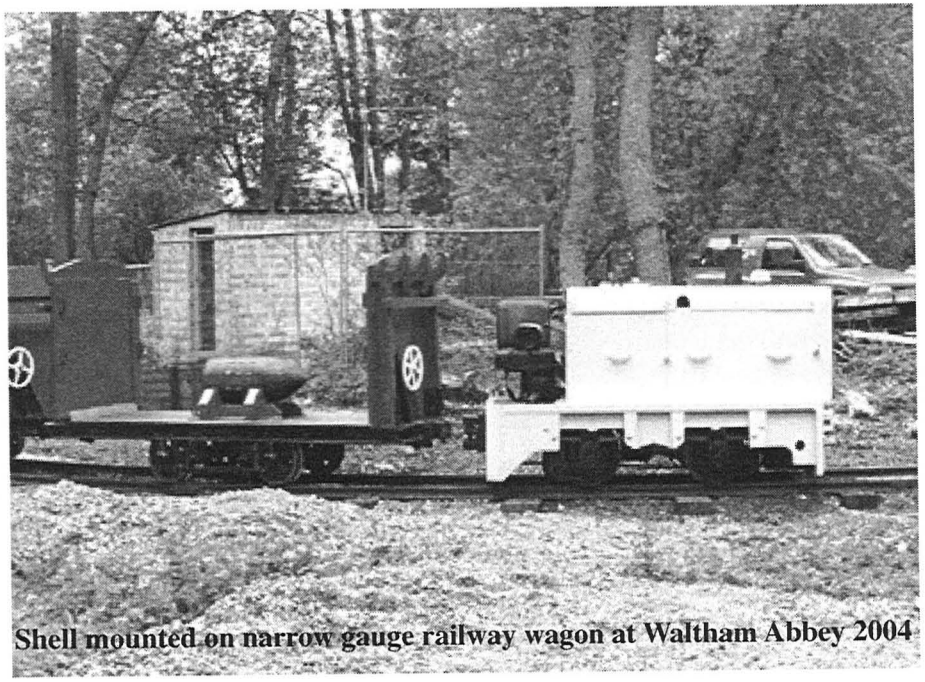
The Hurst Castle guns were installed in the 1860s and (all though, by the 1880s were obsolete) were kept in service (as a reserve) until the end of the 1914/18 war, when they were finally scrapped. The gun in the photos was salvaged from the Isle of Wight and mounted on a simplified replica carriage

I have been asked on a number of occasions, "how were these guns loaded?". Well there were a number of methods, the most sophisticated of which was to turn the gun from it's firing position, through 180 degrees so that it faced a shell hoist and mechanical rammer. The bag of powder (don't forget, this is before the days of cordite) was hoisted from the magazine bellow, level with the muzzle and the rammer operated to drive it home. While this was happening a shell was loaded onto the hoist that had returned to the magazine and once the rammer was withdrawn, raised level with the muzzle and the shell rammed. The gun was then swung back to its firing position.

At Hurst Castle the loading method was much more physical, with the gunpowder charge being loaded and rammed by the gun crew. The shell was then lifted level with the muzzle by crane and again rammed by the gun crew.

It must have been a hell of a job ramming 800 lbs of shell down the barrel of a rifled gun.

In the photos of the gun at Hurst Castle, you can see the ram and other implements needed to load the gun, in a rack directly above the gun position.

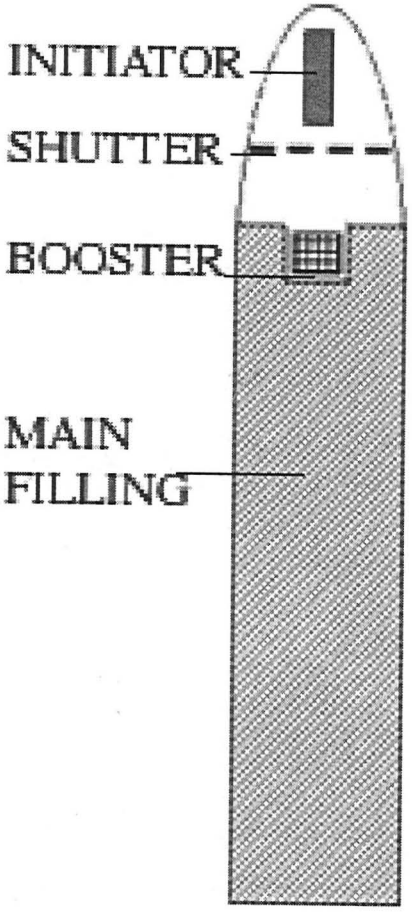


Shell mounted on narrow gauge railway wagon at Waltham Abbey 2004

John Wilson

USES OF TETRYL

Following Les Tucker's excellent article on tetryl readers may be interested in updating the subject to the present day.
Tetryl was originally developed as a high explosive shell filling but, due to its toxic nature it was replaced by TNT, and later RDX/TNT. Modern guided missiles often use HMX/TNT; a somewhat more powerful explosive.



After its use as a main filling was discontinued it was used for some years as a booster explosive to amplify the shock wave produced by the detonator in order to provide reliable functioning of TNT containing main fillings. Although technically very successful in this role it has, more recently, been replaced in most warheads by other less toxic explosives.

However, it still retains one very important use. It is the standard throughout NATO by which all explosives are judged, whether they are sufficiently insensitive to be used beyond the shutter in a shell. Any explosive that is no more sensitive in the Rotter Impact test may be used a booster or main filling in a warhead. The use of tetryl itself is however limited by its toxicity and very little, if any, is now made in

John Wright

SOLVENTLESS DOUBLE BASE PROPELLANTS

Solventless processing was a development designed to overcome the limitations of the solvent system that restricted web size, required stoving which could affect the nitroglycerine content and lead to some distortion of the final product.
In the absence of solvent, gelatinisation is achieved by passing the NC/NG 'crumb' through a pair of steam-heated rolls. The gap between the rolls is progressively decreased until a uniform sheet is obtained.
Rolling is a hazardous operation with energetic compositions and an automatic drencher system fitted with an infra-red sensor is considered essential. Blackened walls in some roll houses seen abroad show that this is not a universally adopted safety feature.
At Waltham Abbey discs were then cut from the rolled sheet as feed stock for the extruder; in contrast to Bishopton which favoured a 'carpet-roll' method.
Higher extrusion pressures for solventless propellants led to the inclusion of extrusion aids, such as Candelilla wax and, as Les Tucker has already pointed out, Carbamite. However, when Lead Stearate was added as a potential extrusion aid it resulted in an unexpected bonus in the form of 'Platonisation' ballistics.
Normally, the burning rate of propellants increases with increased pressure but for platonised propellants the burning rate remains constant over a specific pressure range, or may even decrease depending on the lead salt used. Some copper salts may also enhance this effect. Platonisation also leads to a reduced dependence of burning rate on ambient temperature; a desirable factor in the design of rocket motors.
It is interesting to note, in passing, that Les Tucker has not found any buildings on North Site that were used for rolling so I conclude that P705 on South Site was unique at Waltham Abbey.
Solventless extrusion does allow for larger propellant webs but is eventually limited by the diameter of the barrel of the press and cross-sectional are of the propellant required. The largest press at Waltham Abbey was a mere 10.5 inches (267mm) in diameter compared with 22 inches (559mm) at Bishopton.
Larger web sizes with carbamite stabiliser led to problems of gas cracking and hence research into new stabilisers. Another problem with rolling propellant is that the tensile strength is reduced and which needs to be improved for high acceleration applications.
Finally, to overcome the limitation imposed by press size it is necessary to revert to solvent manufacture for making casting powder for the Cast Double Base system; but that is another story.

Bryan Howard

TOUCH

Despite the risk that some might get bored with this subject I offer one more snippet, attached, goaded as I am by Peter Stone.
More interesting, I think, would be more thoughts on the selective nature of people's memory, and a list of all the propellants P1 and P2 produced for the final user (though we were not formally a factory) and why it was we who had to make them. Peter Stone's comments on Ball Powder and Alcohol dehydration suggest pieces of some sort could also be generated when it looks as if you are likely to be a bit short of content some time. Combustible Cartridge Cases too.
Peter Stone, whose youthful memory of P1 details I view with awe and applaud, suggests I might *knowingly* have failed to recall 'approving' Richard Wallace's manufacturing preferences for NCNM. Tosh, Peter, why should I? Why indeed now should I care?
The process for NCNM was established well before I came on watch, and Richard, who knew what he wanted, would certainly not have put that at risk by asking for a review when nothing had gone wrong.
But in the event that he did ask, and with my memory I really don't know, would I have changed it? I doubt it. I valued his judgement and was happy to back it. And a Superintendent's time is usually engaged in sorting out the things that had gone wrong – Lord knows there were enough of them, though mostly at Bishopton I must add – to find time for, worry about, or even remember, the things that went right. Perhaps others might care to comment on the balance of *their* priorities and memories.
Steve Bell

Letter from America .....I just received the latest edition of Touchpaper - it was a good read as usual.
I have recently moved to Radford Army Ammunition Plant in Virginia as the chemist over the restart of TNT production in the US. We should get our new plant up and running next year with a nominal production rate of 1000kg/hr.
Only slightly removed from my first experience of scale-up - helping on NIMMO and GLYN nitrations with N2O5 at WA South Site. Fond memories, and incredibly about 15 years ago now.
The new TNT process will be genuinely "green" - no red or even yellow water generation. Anyone who worked at WA would feel at home at the Radford plant. It makes NC with essentially the same process (and equipment) that was used 50 years ago along with NG, single and double base gun propellant and extruded double base rocket motors. Despite many advances in technology, NC synthesis and processing remains something of a black art. Being a natural product derivative there are still the same issues with cellulose sources and their effect on product properties that there have been for decades. Analysis is
still based on %N, viscosity and stability tests that would be familiar to everybody who ever worked with NC.

Dr. Andrew Sanderson Energetics Technology Manager

BYTES

If someone had forecast that, one day, I would have ann involvement with an important building, notable for its history and industrial archaeology I would have scoffed - Well, when the Royal Gunpowder Mills Site opened to the public in 2001 I just couldn't keep away. Curiosity and feelings of exhilaration got the better of me and I surrendered. I was asked if I could do something with L168 (the old Mechanics and Engine House to spruce it up a bit and came in regularly a sa volunteer on Fridays to do just that. My first impression was that it hadn't been 'finger marked' by humanity for many years and my first initiative was ton introduce myself to hordes of fat, long-legged spiders on lonely window ledges. After 2 weeks of sweeping and washing down everything in sight a visitor wanted to know what I was up to. He was am amateur film producer and filmed me doing my chores - "Hurrah! I became am overnight celebrity!"
L168 now houses an exhibition of the forms of transport used here including a powder boat, narrow gauge railway engine and 1950s Foden lorry which transported dangerous materials to and from Wales. My favourite was the Ruston railway engine and I promised that his brass plate would always be polished to perfection. I would sit in the passenger seat and drink my morning coffee. After 2 years of weekly attention to the window boxes which flowered constantly I moved on to join the '1787 Island Group' of buildings and those window boxes were transported with me.
Minnie Fenton

Early Industrial Chemistry ...It is not easy to see how Perkin's choice of the benzene-nitrobenzene route to aniline was made, despite nitrobenzene having been the standard approach to preparing aniline since (Ref: Les Tucker To June 2004). Benzene was readily available from coal tar but the early dyes, mauve and magenta, both manufactured in Perkin's factory, required toluidine (amino toluene) for their production. The use of purified benzene as a starting point for aniline potentially seems to reduce the possibilities of toluidines occurring in his product.
Perkin was in a good position to decide however, coming from Hofmann's laboratory in London. Hofmann's own first research was on coal tar aniline (under Liebig), beginning a lifelong interest in amines and other nitrogen-containing compounds. He, and his group, were foremost in their methods and understanding where the chemistry of coal tar was concerned. In the 20 years Hofmann spent in England (1845-1865) he was to successfully train most of the chemists in the English dye industry, thereby becoming a principal figure in establishing organic chemistry in England.
Dave Hartley

DON'T FORGET
DEADLINE FOR THE December 2004 ISSUE:
15th November 2004