

Smokebox Char Recovery

by Doug Landau

Introduction

I first became aware of smokebox char on visits to Willesden shed in 1962. It had the look of miniturised coke, or perhaps smokeless fuel for a doll's house. Discarded in heaps by the track, it seemed to be held in little regard, and would obviously involve manual labour at some future time to effect its disposal. It seemed better use could have been made of it.

Historic Utilisation of Char

I was soon to learn, in Holcroft's Locomotive Adventure, that char was utilised for industrial applications. In 1914, at the behest of Maunsell, inspired by the Great Northern Railway producer gas plant at Colwick, which made use of smokebox char from the engine shed, Holcroft was tasked to look into a similar scheme for Ashford works.

Data on Smokebox Char

Holcroft reported as below.

1: Analysis of moisture-free sample:

Ash	17.30%
Volatile Matter	3.40%
Fixed Carbon	79.30%
Total	100.00%

Sulphur	0.68%
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Calorific Value of Fuel:	11,205 BTU/lb = 26 MJ/kg
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Data on Smokebox Char

Holcroft's report continued

2: Gas Analysis:

CO ₂	7.05%
O	1.26%
CO	23.03%
H	10.03%
CH ₄	0.28%
N	58.46%
Total	100.11%

Calorific Value of Gas

110 BTU per cu.ft
= 4.10 MJ/m³

Data on Smokebox Char

Holcroft's report continued

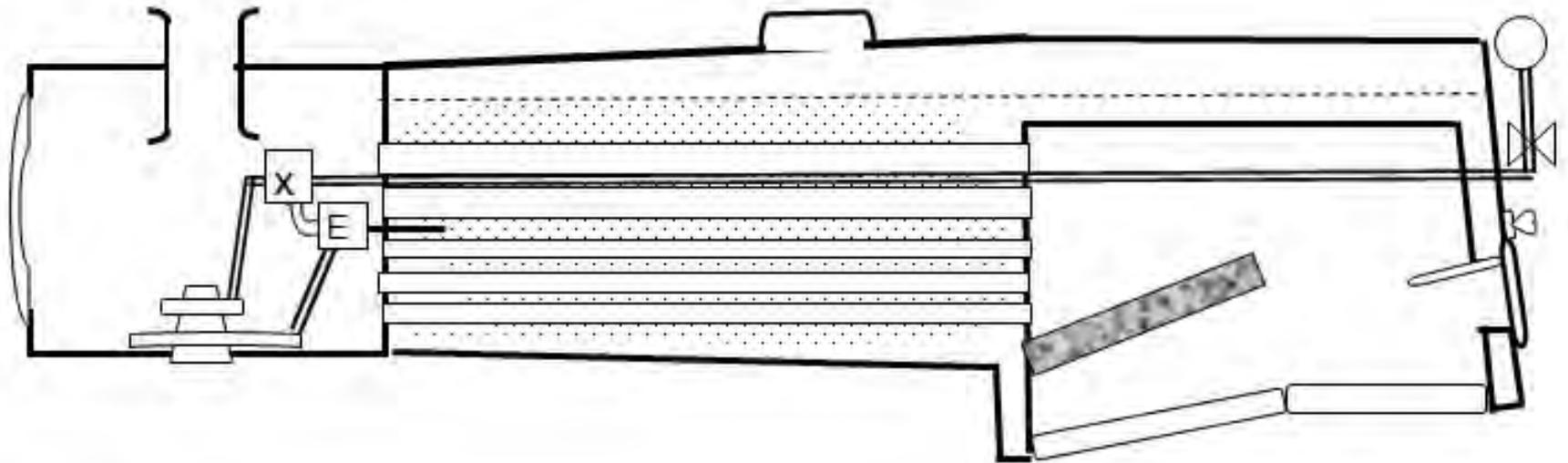
The char was screened, only about 40% of it, apparently, being suitable for the producer gas process. Holcroft does not explain the screening process and criteria. The recovery of smokebox char direct to the firebox being proposed involves no screening, it being considered suitable for combustion as found. Long delayed by the demands of the *Great War*, this project was an eventual casualty, it did not come to fruition.

Char Recycling Objectives

The objectives seek to largely eliminate the labour costs of smokebox cleaning and eventual disposal of char, and its utilisation as a fuel supplement for steam raising. Contemporary mainline steam operations require smokebox screen arrangements to reduce fire risk, smokebox char containment is likely enhanced by these arrangements.

Char Recycling - Procedure Outline

The basic concept is the transfer of char from the smokebox direct to the firebox via a firetube, using a steam operated ejector functioning as a vacuum cleaner.



Char Recycling - Procedure Outline

continued

For obvious reasons transfer of char cannot occur during disposal after the grate has been cleaned, with the boiler still at a usable pressure: the char would just fall through the fire bars into the ashpan. Therefore, the transfer can only occur during steam raising when a firebed has been established and steam has attained the necessary pressure for the ejector to function.

Blowback Hazard

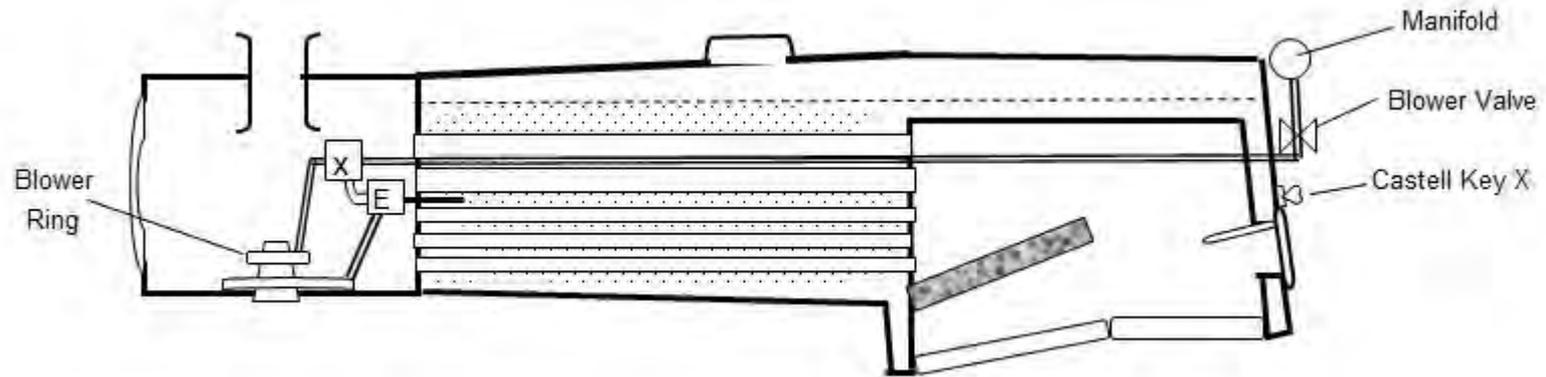
Obviously the procedure described above could give rise to dangerous blowbacks into the cab. A simple interlocking scheme has therefore been devised to enable char transfer only when the following situation obtains:

1. The firedoors are shut
2. The blower is in operation

The simple interlocking scheme involves a single transferable key that is either "free" or "trapped", dependent on circumstances; those being:

Operation

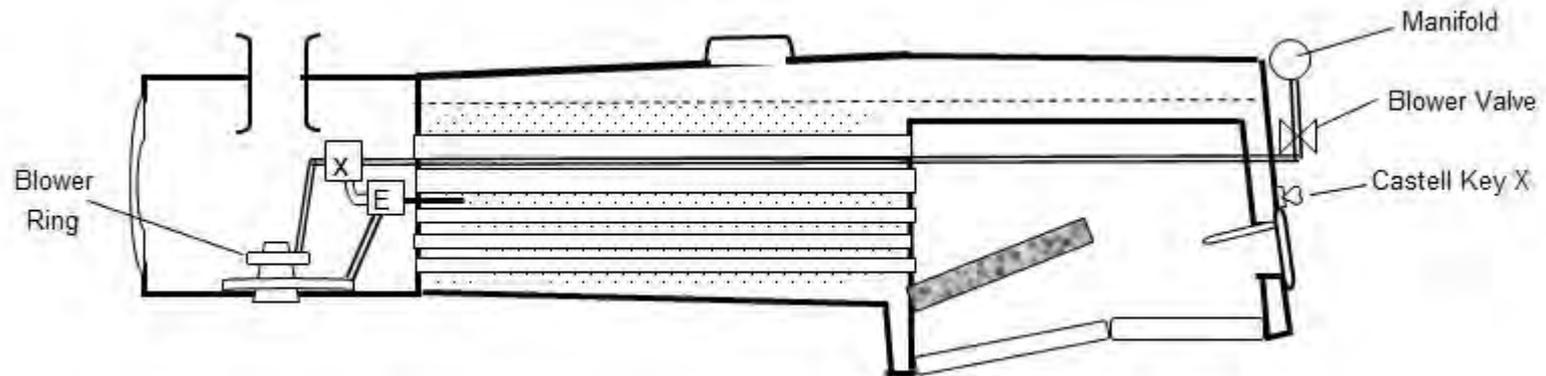
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Char elector E only operable using safety interlock key X.
Key X is only available when firehole doors are fully closed.
The ejector can only function if the blower is in operation.

Operation

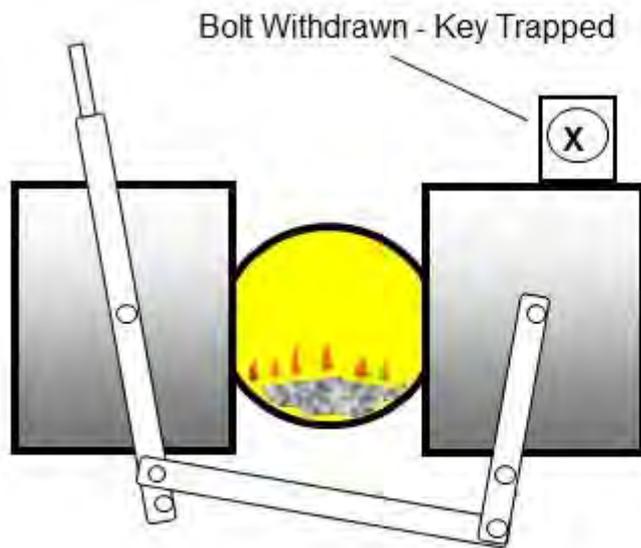
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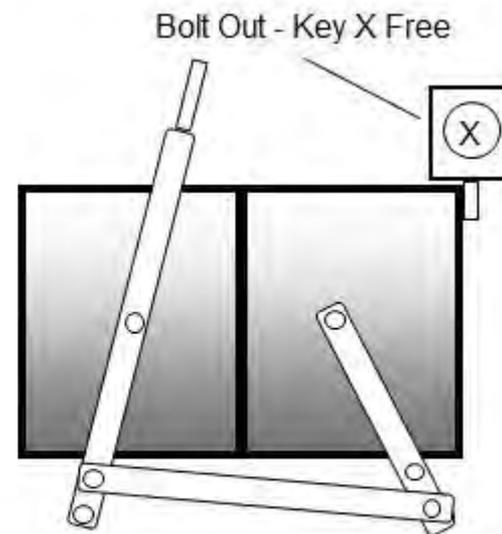
Castell Key X is trapped if the firehole doors are open, it can only be released to operate the char ejector if they are closed and opening the doors is blocked. Additionally, the ejector can only function if the blower is in use.

Char Transfer

1. Fire hole doors closed enabling bolt to be deployed locking firedoors and releasing Key X.
2. Ejector valve operated with Key X, trapping key.



Firedoors Open - Key X Trapped



Firedoors Closed - Key X Released

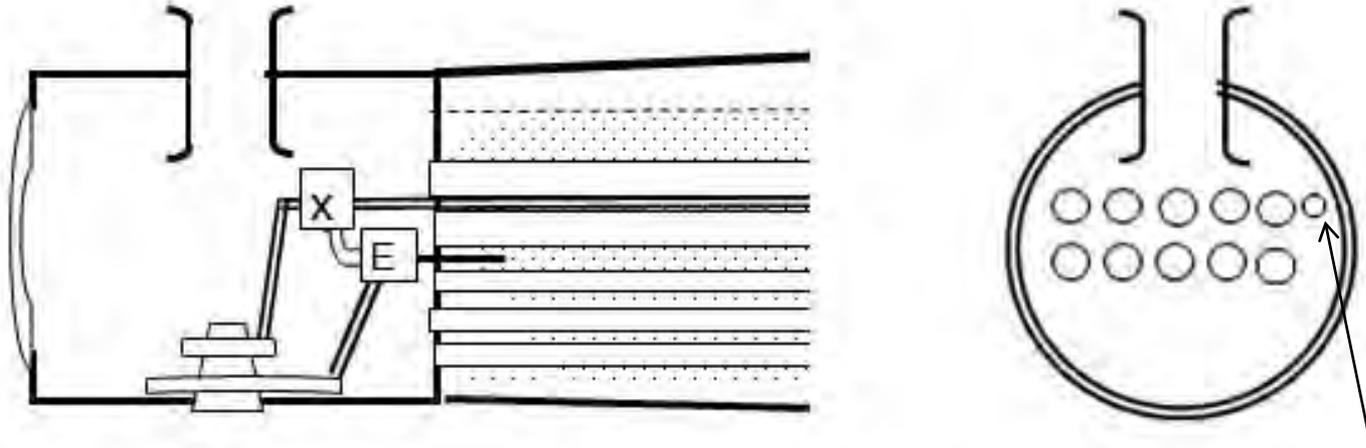


Char Transfer

continued

3. If the blower is not operating the ejector will not function since there will be no steam.
4. On completion of transfer the ejector is shut off, releasing Key X enabling the fire hole doors to be freed for normal operations.

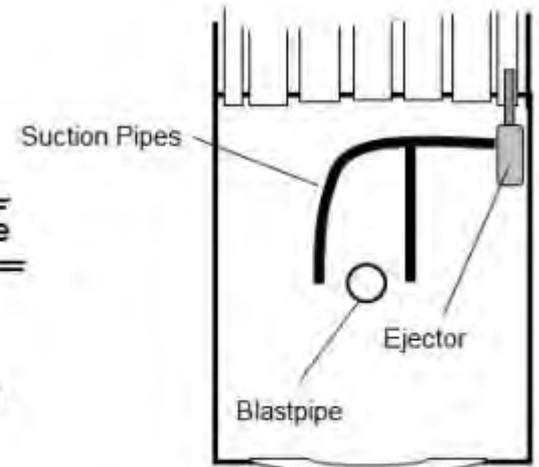
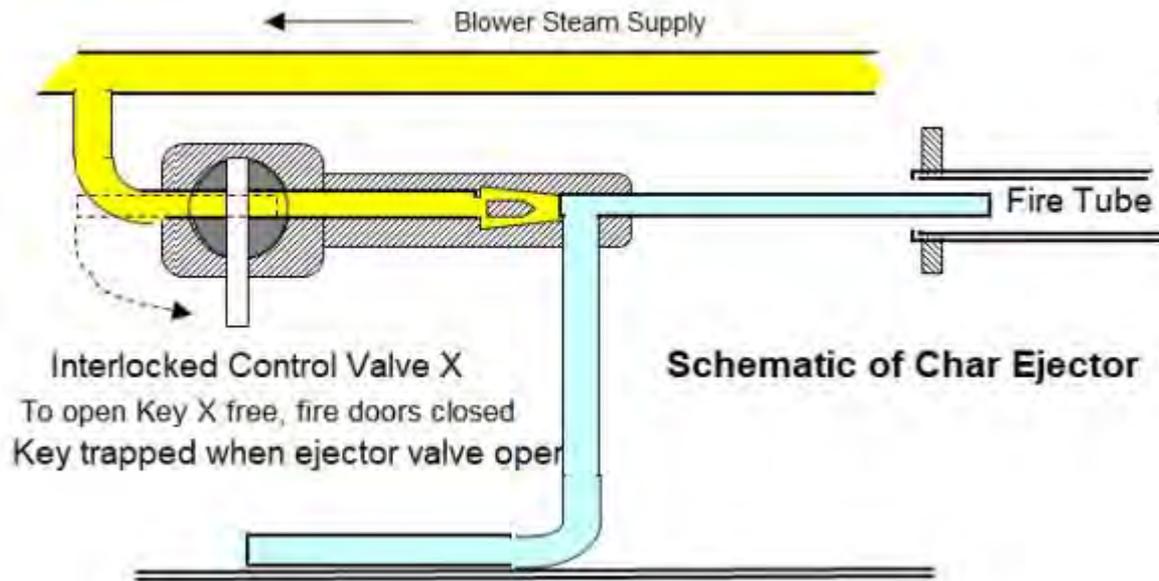
Transfer Fire Tube



The location of a single tube at the highest row adjacent to the smokebox drum was selected on the following grounds:

1. Simplicity, why use more?
2. Clearance of discharge above brick arch.
3. The entraining steam stream may be mollified to some extent in its blow back potential by the vortex effect of hitting the back corner of the firebox.

Ejector Details





Concluding Notes

Interlock System: It is recommended that the rugged Castell type, a standard piece of kit of the power industry for over 100 years, is adopted.

Development: Initially, simple experiments with a vacuum cleaner and manometer could determine the ejector performance to aim for. The next stage would be experiments with compressed air and simple ejector models before anyone need go near a locomotive.