Kent & East Sussex Railway

Operating Department Mutual Improvement Class

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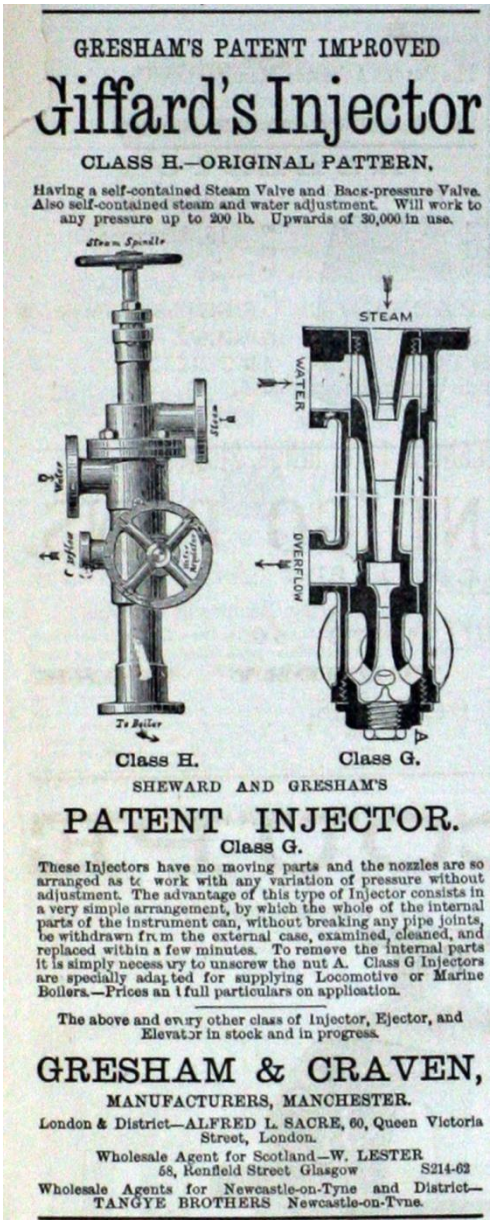
Injectors



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Giffard's Injector

CLASS H.—ORIGINAL PATTERN.

Having a self-contained Steam Valve and Back-pressure Valve. Also self-contained steam and water adjustment. Will work to any pressure up to 200 lb. Upwards of 30,000 in use.

Class H. Class G.

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PATENT INJECTOR.

Class G.

These Injectors have no moving parts and the nozzles are so arranged as to work with any variation of pressure without adjustment. The advantage of this type of Injector consists in a very simple arrangement, by which the whole of the internal parts of the instrument can, without breaking any pipe joints, be withdrawn from the external case, examined, cleaned, and replaced within a few minutes. To remove the internal parts it is simply necessary to unscrew the nut A. Class G Injectors are specially adapted for supplying Locomotive or Marine Boilers.—Prices and full particulars on application.

The above and every other class of Injector, Ejector, and Elevator in stock and in progress.

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Injector Basics

An injector is a device that is used to force water into the boiler against the pressure of the steam contained within the boiler. This is done by transforming the energy in the high velocity steam to pressure in low velocity water. Injectors are needed on steam locomotives to replace the water that has previously been transformed into steam. Prior to the development of the injector, mechanical or steam driven pumps had to be used to replenish the supply of water in the boiler. These could be unreliable and often the locomotive had to be moving for them to work.

However in 1859 the French engineer H Giffard invented the cone injector which allowed water to be replaced without mechanical pumps.

Injectors come in several different types:

Live steam, using fresh steam taken directly from the boiler. These injectors are mounted lower down and when the water valve is opened the water floods into the injector and as such are described as flooding injectors.

Exhaust Steam, using steam that has been used in the cylinders. These injectors are mounted lower down and when the water valve is opened the water floods into the injector and as such are described as flooding injectors.

Lifting, these are usually of the live steam type but are mounted on the boiler backhead or on top of the side tanks. These injectors lift the water into the injector before feeding it into the boiler. These types of injectors are often more accessible but are usually only found on smaller industrial locomotives.

All of these injectors work using three essential cones;

- Steam Cone (convergent in shape)
- Combining Cone (convergent in shape)
- Delivery Cone (divergent in shape)

Steam from the boiler is admitted into the steam cone and as it is allowed to expand from a higher pressure to a lower pressure a certain amount of heat energy is available for conversion into work. This is used giving the steam velocity in the direction of flow out of the smallest end of the converging cone. As the jet of steam leaves the steam cone it comes into contact with cold water which is admitted from the inlet and surrounds the tip of the cone.

In the combining cone this cold water mixes with the steam and causes it to condense. At the widest end of the cone the mixture comprises of both steam and water but as the bore of the cone decreases the mixture condenses until at the narrow end of the cone a solid stream of combined water is formed. The condensing steam transfers some of its energy into the water as velocity energy and some into heating the water by about 100°F or 38°C.

This solid stream of high velocity water then jumps a small gap, known as the overflow and enters the delivery cone. The overflow gap is used during the starting operation of the injector and exhausts any steam or water that is wasted before condensation and peak operation is reached.

The delivery cone is divergent in shape with the jet of water entering at its smallest end. The cone is designed to return the velocity energy back to pressure energy as uniformly as possible as the momentum of the jet passes through it. The result is that the pressure of the water leaving the injector is higher than that contained in the boiler and results in the stream of water being fed along the delivery pipe and past the clack valve (a one way check valve) into the boiler.

Common Injector Faults

There are several reasons why an injector may not start to work or why it may stop working during operation:

- Feed water too warm affecting the condensation in the combining cone
- Obstruction in tank or pipework
- Cones out of alignment
- Grit or foreign objects in cones
- Air Leaks in pipework affecting the stream of condensed water.
- Overheating of injector from steam leaking past the steam valve.
- No feed water in the tank

Injector Hints and Tips

All of the locomotive fleet at the KESR are fitted with two injectors. These must be tested before going of shed.

It is good practise to alternate injectors during the day so that both injectors are used regularly.

Steam valves should be shut off tightly to minimise the risk of steam leaking past the valve and causing the injectors to overheat.

On locomotives fitted with lifting injectors it is good practise to carry a bucket of cold water to help cool an injector should they overheat.

Any faults with an injector should be reported to the shed staff and reported in the locomotive fault book.