Kent & East Sussex Railway

Operating Department Mutual Improvement Class

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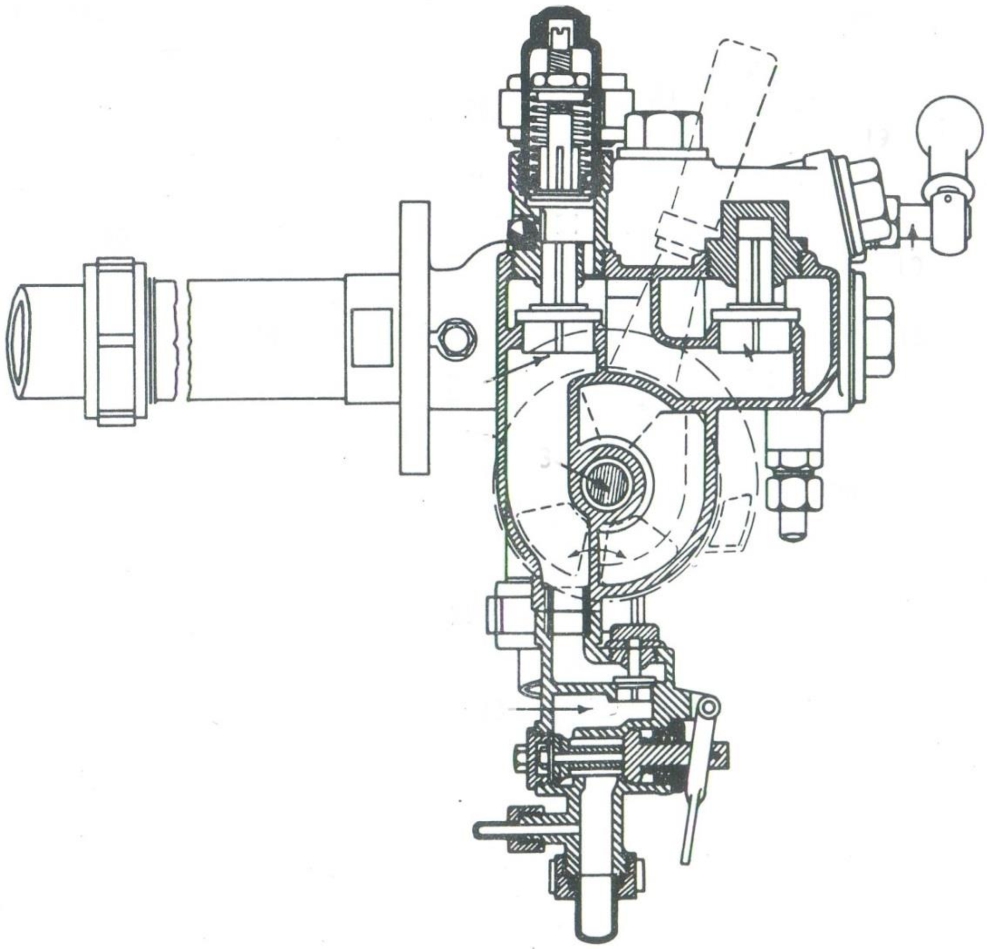
# Brake Ejectors and Vacuum Pumps



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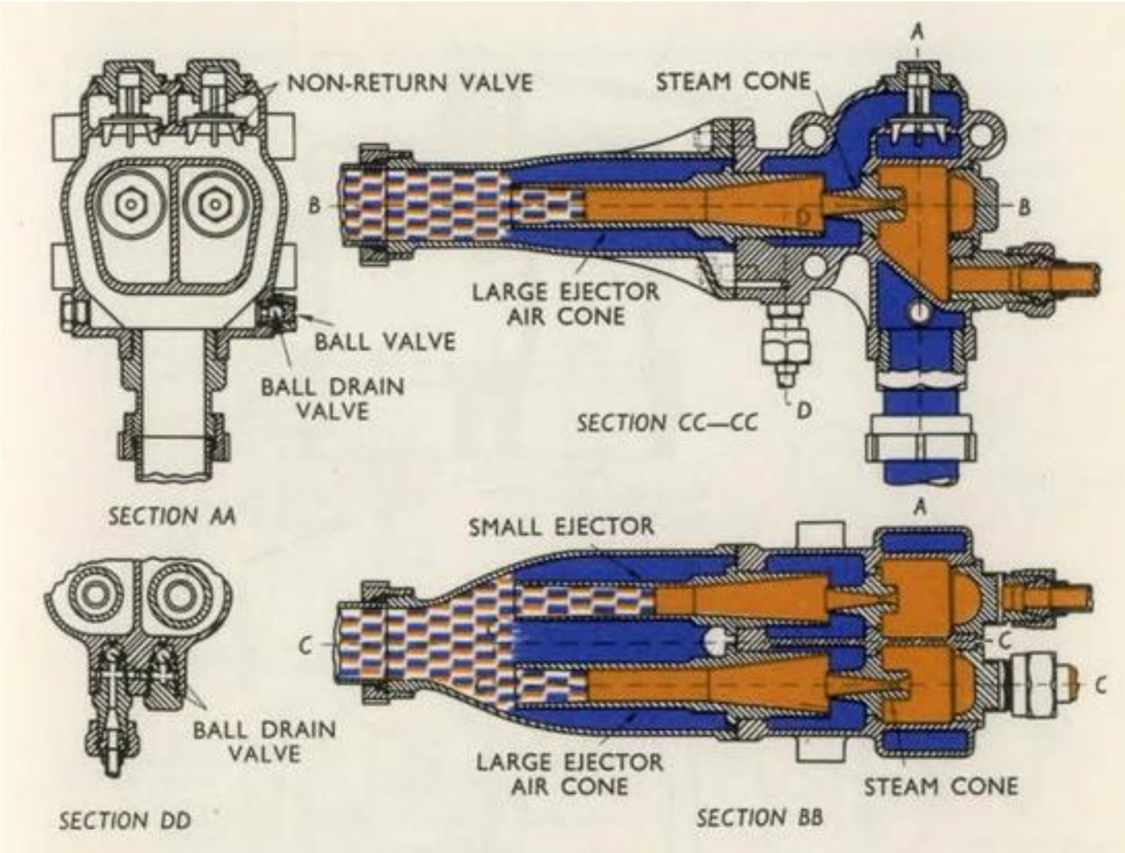
**Brake Ejectors**

A brake ejector is the exhausting device used with the automatic vacuum brake to create and maintain the vacuum. The most common type of ejector is the combined type with includes both a large and a small ejector which work independently of each other. The ejectors will be housed either with the drivers brake application valve or separately; as with the BR standard designs where they are placed outside of the cab. The brake apparatus will always consist of a large ejector. Where a small ejector is not provided, a vacuum pump may be provided instead. Where fitted, a vacuum pump will be external to the brake ejector, usually housed on the locomotive frames and driven by the motion via a crosshead.




All brake ejectors in use on the K&ESR are housed with the drivers brake valves, but operate in the same way as those which are housed separately. For simplicity, this image shows a combined large and small ejector housed separately from the drivers brake valve. Also shown are the non-return and drain valves. The workings of these are explained below.

When the ejector is running, steam is passed through the steam cone which is shaped so that the pressure of the steam is converted into velocity. The steam, now moving at high velocity, is discharged into the ejector air cone where it comes into frictional contact with the air. The friction causes the air to be dragged out of the train pipe and through the ejector towards the ejector exhaust pipe, where it is exhausted to atmosphere via the smokebox and chimney. The frictional action of the air being dragged out of the train pipe causes a partial vacuum to be created.

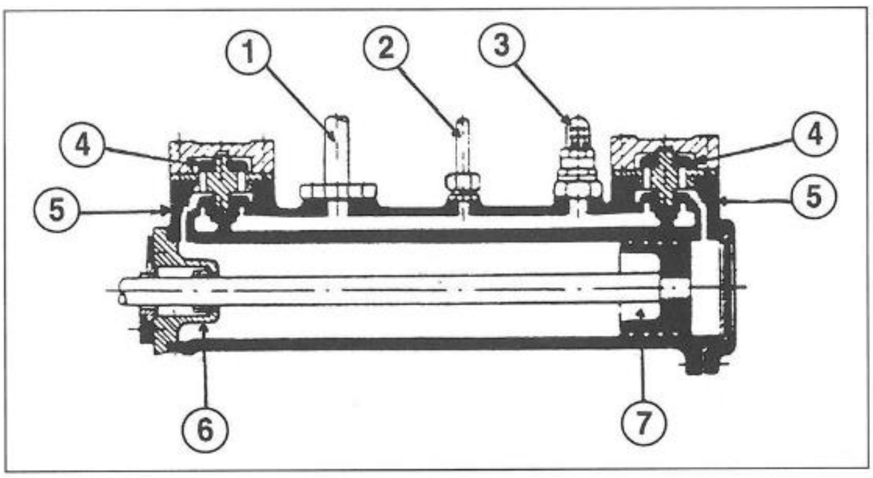
Each ejector is fitted with a non-return valve. The non-return valve prevents smokebox gases being drawn back through the ejector when the steam supply is turned off. As the partial vacuum is created any air resisting the creation of vacuum in the train pipe and various connections will lift the non-return valve and find its way to the ejector where it will be exhausted. The process will continue until a vacuum is created. At this point the non-return valve will close to prevent air and smokebox gases from returning through the ejector, destroying the vacuum that has been created in the train pipe and connections.

The action of the large and small ejectors is similar, the difference being that the large ejector uses more steam. The large ejector is therefore capable of creating a vacuum more quickly and is for use when first creating a vacuum or for when a quick release of the brake is required. Due to the amount of steam used by the large ejector, it is not suitable for use during the running of a train. This would also work against the general principle of gradual application and release usually employed to provide smooth braking. The small ejector uses less steam so can be left running constantly, but will only be enough to maintain the vacuum against leakage and to gently recover from moderate brake applications. A vacuum pump would serve the same purpose as a small ejector, but would not use any steam.

A ball drain valve is provided under each ejector to release any water that builds up through the action of condensation. Whilst the ejectors are in use the ball is forced to its seating by the passing steam; preventing air from entering via the drain. When the steam supply is turned off, the ball falls away from the seating and allows any condensation to drain away. The reason for using a ball valve is to provide the ejectors with a second line of protection if there is any leakage past the non-return valves. In this case, the ball valve will open to atmosphere and release any smokebox gases so they are not drawn back through the ejectors. At the same time, the ball valve allows the vacuum to be maintained in the train pipe while the ejector is shut off.

**Vacuum Pumps**

Vacuum pumps are usually found fitted to locomotives of Great Western design. As the name suggests, they consist of a piston contained in a pump. The pump is double acting which means that it can pump air from both ends of the piston. Below is a diagram of a vacuum pump, followed with a description of its working.



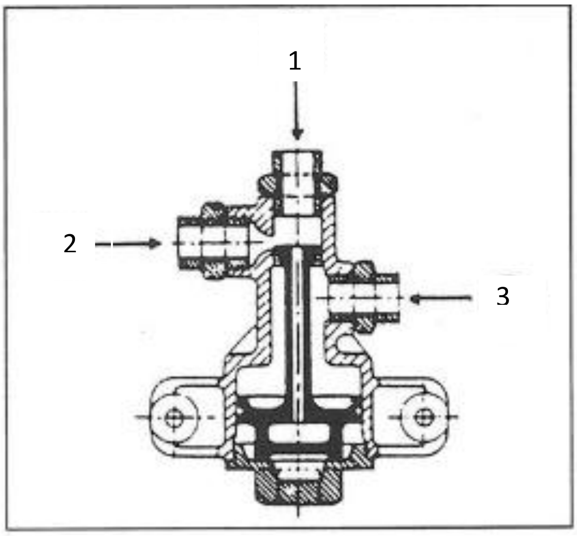

**Great Western Railway Vacuum Pump**

1) Pipe Connection
2) Lubricator
3) Vacuum Adjuster Valve
4) Outlet Valve
5) Inlet Valve
6) Gland
7) Piston

Both ends of the pump have an inlet and an outlet valve connected to the train pipe via a chamber on top of the pump. As the piston moves from one end of the pump to the other, air is drawn out of the train pipe via the inlet valve and into the pump. When the piston completes its stroke and returns in the opposite direction, air is drawn from the train pipe via the inlet valve at that end, and the air from the previous stroke, now trapped in front of the piston, is pushed out to atmosphere via the outlet valve at the opposite end.

On top of the pump is a lubricator which feeds pump oil (usually 50/50 220 grade oil and paraffin) to the pump to prevent the piston from ceasing. **Note* Pump oil should always be mixed by a fitter.** Also found on top of the pump is the vacuum adjuster valve, which sets the maximum vacuum the pump can create (usually 25 inches for Western locomotives).

Most Western locomotives fitted with a vacuum pump are also fitted with a retaining valve. When a brake application is made, the change in pressure in the train pipe moves the shuttle in the retaining valve so that the pump is cut off from the train pipe. This allows the effort of the pump to be put solely into maintaining vacuum in the reservoir and prevents it from trying to overcome the brake application.




Vacuum Retaining Valve

1) Connection to train pipe.
2) Connection to pump.
3) Connection to reservoir.

For further information on the various designs and operation of the automatic vacuum brake, see the separate piece on the MIC website.