

# Modification of "West Country" Class Pacific



Photo]

[J. A. Badham

**Modified "West Country" class Pacific No. 34005, "Barnstaple," approaching Ashford with the 10 a.m. Victoria to Dover Marine boat train on August 19**

**T**HE first of the Southern Region "West Country" class 4-6-2 locomotives to undergo extensive modification, No. 34005, *Barnstaple*, is now in service. Initially, a further 14 are being similarly altered.

The "West Country" class locomotives were introduced on the Southern Railway in 1945, and were a lightweight version of Mr. O. V. S. Bulleid's "Merchant Navy" class Pacifics. Of the 110 locomotives of this class, 104 were built at Brighton, and the remainder at Eastleigh, between the years 1945 and 1951. They include, in addition to those named after places in the West Country, others which bear names associated with the Battle of Britain.

They incorporate most of the same design features as did the "Merchant Navy" class locomotives when built, a number of which are unusual in British locomotive practice. Among these features are: (a) A three-throw crank shaft, chain-driven from the driving axle, which operates valve gear for each of the three cylinders. Each gear is connected to its respective piston valve through a rocking lever arrangement having a 3:8 ratio; (b) An oil-bath enclosing the three sets of special valve gear and the inside

motion. This is intended to give continuous lubrication to the working parts; (c) A smokebox of irregular shape, as opposed to the more usual cylindrical form; and (d) Light plate casing over the whole of the upper part of the locomotive.

As was the case with the "Merchant Navy" locomotives, some of these features have proved troublesome, and this in turn at times has reflected on performance as well as on maintenance. In addition the consumption of coal, oil and water has been fairly high in comparison with other modern locomotives. A number of the "West Country" class are, therefore, being modified on similar lines to the "Merchant Navy" class, in accordance with designs prepared at Brighton under the direction of Mr. W. J. A. Sykes, Chief Mechanical & Electrical Engineer, Southern Region, in consultation with Mr. R. C. Bond, Chief Mechanical Engineer, British Railways Central Staff, British Transport Commission. The work of preparing the new details is being carried out mainly at Eastleigh Locomotive Works with assistance from Ashford Works.

Principal particulars of the modified "West Country" class 4-6-2 locomotive are as follow:—



Cylinders (3), dia. and stroke	...	16 $\frac{1}{2}$ x 24 in.
Wheels:		
Coupled, dia.	...	6 ft. 2 in.
Bogie, dia.	...	3 ft. 1 in.
Trailing, dia.	...	3 ft. 1 in.
Heating Surfaces:		
Tubes	...	1,869 sq. ft.
Firebox (incl. syphons)	...	253 sq. ft.
Total evaporative	...	2,122 sq. ft.
Superheater	...	488 sq. ft.
Grate area	...	38.25 sq. ft.
Boiler pressure	...	250 lb./sq. in.
Tractive effort	...	27,720 lb.
Adhesion factor	...	4.72
Weight of engine in working order	...	90 tons 1 cwt.
Weight of engine and tender in working order (with 4,500 gal. tender)	...	132 tons 13 cwt.
Weight of engine and tender in working order (with 5,500 gal. tender)	...	137 tons 6 cwt.

The three-cylinder arrangement is the same on the modified locomotive, with the cylinders in their former positions, driving on to the middle coupled axle. A new inside cylinder is provided, but the two existing outside cylinders have been retained. The cylinder dimensions, 16 $\frac{1}{2}$  in. diameter and 24 in. stroke, are unchanged, and the piston valves remain at 10 in. diameter. The inside cylinder is a steel casting, having cast-iron liners to both the cylinder barrel and the steam chest, the latter being offset to the right, and arranged for inside admission. The steam chests of the outside cylinders are placed on the same vertical centre line as the cylinders and are arranged for outside admission.

The piston rods are provided with a special type of cast-iron packing, and this is also used for the valve spindles of the outside cylinders; experience on the modified "Merchant Navy" class has shown it to be entirely satisfactory for the high-pressure gland made necessary by outside admission. The piston rods are attached to the piston heads by means of a parallel fastening and to the new crossheads by normal cone and cotter. The cylinder cocks are steam operated.

The oil bath, which is a feature of the original locomotives, has led to an excessive use of oil and also corrosion of the steel motion details because of the entry of water, causing emulsification. The oil bath has thus been dispensed with, and the motion and valve gear of the inside cylinder are no longer completely enclosed, enabling the various working parts to be readily examined.

Three independent sets of Walschaerts valve gear are provided and are almost exactly similar to the new valve gears fitted to the "Merchant Navy" class.

The outside gears are arranged for outside admission to suit the existing cylinders and, because of the offset between the centre line of the valve gear and the axis of the steam chest, a suspension link is fitted to carry the weight of the valve gear and eliminate the normal valve spindle crosshead guides. The piston valves for the outside cylinders have a maximum travel of 6 $\frac{1}{2}$  in., and each head is fitted with four narrow rings. The return crank rod is attached to the return crank through a self-aligning ball bearing.

The inside valve gear is driven by an eccentric mounted on the right-hand crank web of the driving axle; it is spigoted to the web and held in position by five studs. The new valve gear is of orthodox design, and is arranged for inside admission; the maximum travel is 6 11/32 in. The steam reversing gear has been replaced by a manual reversing gear, the screw of which is located on a bracket attached to the outside of the main frame midway between the left-hand driving and trailing coupled wheels. This is operated by a shaft, fitted with universal joints, from the cab, which contains only the handle, spur gearing, locking gear and cut-off indicator. A short bridle rod connects the reversing screw nut to the reversing shaft; the latter, having three arms, controls the three valve gears without the use of an intermediate reversing shaft. The handle in the cab is "face-on" to the driver, and the cut-off indicator is of the drum type.

The smokebox of irregular shape, as originally fitted, has been dispensed with and replaced by a cylindrical smokebox resting on a saddle. As in the case of the modified "Merchant Navy" class, this saddle is formed partly by the upper portion of the new inside cylinder and partly by a new fabricated saddle stretcher which is bolted to the front of the cylinder casting. The multiple-jet blast pipe has been retained, but a new cast-iron chimney of large diameter has been provided, this being fitted with a petticoat and ejector exhaust ring. No self-cleaning plates are visualised, experience with the modified "Merchant Navy" class having shown that the shape of the smokebox itself makes it reasonably self-cleaning. The existing smokebox door of elliptical shape is retained, but the superheater header has been renewed

so as to provide three flanges for individual steam pipes to each cylinder.

The air-smoothed casing, which formerly enveloped the upper part of the locomotive, has been dispensed with, and the boiler is provided with the normal type of clothing plates mounted on crinolines. Footplating along the sides of the engine follows, generally, the form of that on British Railways standard locomotives. It is, however, carried by brackets from the main frame, except for the portion adjacent to the firebox. Smoke deflector plates are provided on each side of the smokebox.

No substantial alteration has been made to the boiler, which retains its steel firebox and thermic syphons. The former grate, which incorporated both rocking units and a "drop" section, and which has been found somewhat unreliable in service, has been replaced with the type of grate used on the standard locomotives, having unit firebars which are assembled on their respective carrier bars by sliding into position. The rocking sections are divided into two groups which can be rocked separately, being situated on either side of the longitudinal centre line. In each group, there are five carrier bars, each fitted with 15 unit firebars.

The ashpan previously fitted to the majority of the "West Country" class locomotives was without damper doors, permanent openings being provided for the inlet of air to the grate. While simplifying the construction of the ashpan and eliminating damper doors and operating gear, this arrangement has, on occasion, made the control of the fire and the prevention of blowing off at the safety valves somewhat difficult. An entirely new ashpan has, therefore, been fitted and this is provided with damper doors and the standard type of butterfly doors at the bottom for self-emptying.

The ashpan is divided into three parts; there is a central section between the frames, and two outer sections, all three of these being in the form of hoppers. Each of the three sections has a damper door facing forwards. The three damper doors are in line, and are connected to a transverse operating shaft fitted with a simple type of universal joint in order to eliminate any tightness which might be caused by slight distortion of the ashpan. A similar arrangement is applied to the hopper doors at the bottom; these latter

are operated from the ground by means of a short lever, which takes the same bar as that used for operating the rocking grate. The operation of the damper doors is by a single screw control on the footplate.

The first 70 "West Country" class locomotives were originally designed so as to be able to work on the direct route from London to Hastings *via* Tonbridge, where the loading gauge is severely restricted through certain tunnels. The width of the cab, therefore, was limited to 8 ft. 6 in. and this has tended to restrict the forward vision through the cab windows. In fact, the "West Country" class has never been used on the Hastings route, and now, with the adoption of diesel-electric trains, there is no longer any reason for the retention of the narrow cabs. The opportunity, therefore, has been taken to move the cab sides outwards and fit a new centre roof section so as to bring the cab width up to 9 ft. 0 in., as in the case of the "Merchant Navy" class and the final 40 "West Country" class engines. In addition, the lower portion of the side sheeting is cut away and the new type of link-supported cab roof ventilator fitted.

Little alteration has been made to the driving controls attached to the boiler, but the elimination of the steam reversing gear and its replacement by a handwheel, gearbox and indicator drum has altered the layout on the left-hand side. The "Ajax" type of firehole door is retained, but the steam-operating mechanism has been dispensed with. The firehole itself is fitted with a deflector plate in order to improve combustion.

Two mechanical lubricators are situated on the footplating over the leading pair of coupled wheels on each side of the locomotive. They are driven by a short arm mounted on the outside expansion links. Three of these lubricators, each with six feeds, have been removed from their former position in front of the smokebox and are used for supplying the cylinders and steam chests with superheater cylinder oil. The remaining lubricator, which is fitted on the right-hand side of the engine, has twelve feeds and supplies engine oil to the axleboxes and so on. The oil to the steam chests is atomised and is introduced into the steam pipes, feeding each of the three cylinders. The barrels are lubricated by

non-atomised feeds passing through the cylinder walls near the vertical centre line at top and bottom. Other feeds pass to the piston rod packing and the valve spindle rear bush. The coupled axleboxes are, at present, fed with engine oil at the crown but, in due course, as the existing axleboxes have to be renewed, the feed will be transferred to the tray which accommodates the oil pad on the underside of the bearing.

The provision of mechanical feeds to the axleboxes eliminates the large multi-feed oilboxes formerly fitted in the cab. Mechanical feeds are also used for the slidebars and the inside valve spindle crosshead guides. The axlebox guides and inside piston rod swab box are lubricated by means of trimming feeds in small auxiliary oilboxes attached to the footplating, similar oilboxes adjacent to the point of application lubricating the outside piston rod swab boxes. The majority of the valve gear is lubricated by grease.

Because of the removal of the casing over the upper part of the locomotives, the previous sandboxes have been replaced by new ones; those for the leading pair of wheels are placed above the footplating adjacent to the back end of the smokebox, and those for the driving pair of wheels between the frames. Steam sanding gear for the leading and driving coupled wheels is arranged for forward running. In addition, sandpipes are provided behind the driving wheels for reverse running, and replace the gravity sanding gear which was previously fitted

to the front end of the tender for this purpose. Steam sanding is thus provided for both forward and reverse running.

The drawgear between engine and tender has been modified in a similar manner to that which has proved beneficial on the "Merchant Navy" class, and incorporates a plunger, sliding in guides in the tender dragbox, which is pin-jointed to the drawbar itself. The plunger is controlled by a heavy rubber spring drawing the engine and tender together, and bringing the curved rubbing blocks into contact. These rubbing blocks, faced with manganese steel, are so shaped that relative lateral movement between engine and tender does not increase the loading of the drawbar and spring.

To facilitate the taking of water, the side raves of the tender have been cut away, this having the effect also of eliminating pockets where surplus coal tends to accumulate uselessly. Casings have been placed over the vacuum reservoirs situated on the top of the tank to the rear of the coal bunker, also to eliminate accumulations of coal. Compartments for the fire irons are provided on each side of the bunker. External feed sumps with shut-off valves have been added to enable the sieves to be removed and cleaned without emptying the tank. This feature has been found effective in reducing injector trouble, resulting either from the clogging of sieves or the choking of the annular orifices of the injectors by fine particles of coal. A water level indicator of the float type is provided,