SteamRanger's Heritage
- an insight into our past

BACKGROUND

In the July1993 issue of Catchpoint, the editor wrote:

"R ecently a series of promotional papers prepared by the South Australian Railways Mechanical Department some years ago have come to light.

For the interest of readers the paper concerning the "520" class is reprinted hereunder. It should be noted that when this paper was drafted the locomotives had not fitted with oil burners".

THE S.A.R. 520 CLASS LOCOMOTIVE

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520 class locomotives, which were designed by the Chief Mechanical Engineer of the South Australian Railways were first placed in traffic on the 10th November, 1943. There are twelve of these locomotives, numbered 520 to 531.

This type of locomotive was designed for a speed of 70 miles per hour and is for use on either fast passenger or freight train working.

It incorporates all recent improvements in locomotive construction and may be accepted as representative of the most recent developments in locomotive practice.

A special feature in the construction of these locomotives was the fitting of roller bearings to all axles, both engine and tender. They remove the side friction which now takes place with solid bearings in that all horizontal thrusts are taken by the rollers and not by the hub liners against the box of the wheel, eliminating lateral wear on the hub liners. As a result, the only necessity to remove the wheels of these engines will be for flange wear and not lateral wear. In addition, the reduction in friction of bearings will enable the 520 class locomotive, when working on curves, to handle a greater load at increased speeds that would normally be obtained with solid bearings. It is the first locomotive in Australia of this type to have all wheels fitted with roller bearings.

The leading coupled wheels and the leading wheels of the trailing truck are fitted with a lateral motion device, the leading coupled wheels being spring controlled whilst the trailing truck is of constant resistance. The leading bogie and the four wheel engine trailing truck are fitted with constant resistance lateral control rockers. The lateral device fitted to the leading coupled wheels and leading wheel of the trailing truck has reduced the fixed wheel base and, in addition, has reduced the resistance of the locomotive on curves.

The piston valves are of 12 inch diameter, and provide area for efficient distribution of the steam, and are operated by Walschaert Valve Gear.

Piston rods and valve spindles are fitted with packing of the spring loaded type having a single ring of copper lead mixture.Pistons are of cast steel light weight design and are fitted with segmental rings. The rings provide all the bearing area to support the piston. The segmental construction, supplemented by an expanded ring which acts as a locking member, results in less spring tension to set out the ring against the cylinder walls. The rings are a combination of bronze and cast iron segments.

The regulator is of the balanced type fitted within the dome and so balanced that permits easy operation. The engine is fitted with air operated power reversing gear, and is also equipped with cut-off control gauges and indicators to enable the engineman to control the locomotive with the greatest efficiency. All controls and pressure gauges are placed within easy reach and vision of the engineman

The cylinders are of welded steel construction and have been designed to provide liberal area through steam and exhaust ports and are the first in Australia to be of all welded steel construction. Cast iron liners are fitted in the cylinder barrels and steam chests. The welded cylinders have enabled a saving in weight of 14% over cast iron cylinders..

The frames are of cast steel, built up type, with two main cast steel bar frames bolted together, with cast steel frame braces. They are fitted with adjustable top spring controlled tapered wedge - the horn cheeks are lined with phosphor bronze wearing shoes which are grease lubricated.

The locomotive is designed for conversion to standard gauge. The only alteration necessary for the conversion will be the replacement of the existing wheel centres and shortening of the brake hangars cross beams.

The locomotive is fitted with two mechanical lubricators, one for feeding the main and valves, whilst the second is an automatic lubricator for the air compressor. Seven locomotives are fitted with the latest type of Davies and Metcalfe exhaust steam injector on the right hand side and the left hand side is a Nathan non-lifting injector; the former having a capacity of 3,600 gallons and the later a capacity of 3,500 gallons per hour. The remainder of the locomotives are fitted with Nathan non-lifting injectors on the right and left hand sides with a capacity of 3,500 gallons per hour.

The boiler is of ample capacity to supply sufficient steam to the cylinders so that maximum horsepower can be developed for long periods. The boiler is of the Belpaire type with a working steam pressure of 215 Ibs. per square inch, and is fitted with the Superheater Company's Type A.M. Header. The firebox is of all welded steel construction. Two thermic syphons have been fitted in the firebox, which increases its steaming capacity and boiler efficiency, further adding to the saving of coal. The tube plate, door sheet and syphons joint are all butt joints electric welded, no riveted joints being used in the firebox. Flexible stays have been provided throughout the breaking zone to reduce breakages, hollow stay bolt steel being used for flexible stays and crown stays.

The boiler is provided with two plunger type blow off cocks, one on each side of the firebox, operated by levers adjacent to the driver and fireman's seat in the cab. The right hand blow of cock is provided with a blow down muffler. In order to complete all twelve locomotives, it was necessary to build two all welded four wheel trailing trucks and two all welded rear end frame extensions in place of steel castings being used on the other locomotives, the saving in weight being 12 % for the trailing truck and 14 % for the rear end frame extension.

The locomotive is equipped with staff exchanger gear for the purpose of exchanging staff at run through stations at up to 50 miles per hour. The gear is operated from within the cab.

The engine is fully streamlined and is fitted with a roomy totally enclosed cab, which is well ventilated and has large sliding windows giving excellent lighting to that compartment and provides extended vision of track and maximum comfort for engine crews. The locomotive is equipped with electric light generated by a turbo generator placed in front of the smokebox. The streamlining has been so arranged that it does not in any way interfere with accessibility for maintenance purposes; the front portion being carried on hinges will readily swing out of position and expose the smoke box door. For ordinary examination the smaller smokebox door can open inside the front extension nose.

The locomotive is fitted with a hopper ashpan of ample capacity for the longest locomotive run. The ashpan is fitted with a sliding horizontal door operated by an air cylinder.

The main particulars of the locomotive are	
Gauge	5' 3"
Piston stroke	28"
Cylinder diameter	20 ½”
Wheels, coupled, diameter	5'6"
Wheel base, coupled	17' 9"
Wheel base, engine	41'1"
Superheater	651 sq. ft.
Grate area	651 sq. ft.
Boiler pressure	215 Ibs. per sq. in.
Tractive force at 85% boiler pressure	32,600 lbs.
Boiler Heating Surfaces	
Small tubes and flues	2,163 sq.ft.
Firebox and syphons	291sq. ft.

The use of welding has saved considerable weight in material and made it possible for the locomotive to be within the limits of weights set down for operation on 60 Ibs rail. With the exception of the boiler plates, roller bearings and exhaust steam injectors, the remainder of the material was produced in Australia. The whole of the fabrication of the locomotives was carried out at the Islington Workshops of the South Australian Railways. The smokebox is fitted with self-cleaning front end and radial ported exhaust nozzle and double draft petticoat.

Due to the extra distance between smokebox tubeplates and chimney, on account of the long wheel base and the desire to keep the maximum length of tubes to 19' 0", it was found necessary to fit a false diaphragm to reduce the smokebox volume.

Tender

The tender is of welded steel construction with self trimming coal bunker. It is also equipped with Westinghouse automatic (hydrostatically controlled) variable load brake, and is carried on two six wheel bogies to conform to limits of axle load set down for 60 Ib. rails.

The tender tank is welded to an all welded steel structure which forms the bottom of the tank in place of a steel casting, the saving of weight being 33%. Spot welding was largely used in the construction of the tank, all side stiffening plates being spot welded, the maximum added thickness being 1/2 " The bogie frames are of all welded design fabricated from plate and pressing, and show a 22% saving in weight over the cast steel bogie.

The capacity of the tender tank is 9,300 gallons of water and 9 3/4 tons of coal. The tender bogies are fitted with clasp brakes with slipper brake blocks.

Since being issued to service, engine No. 520 has undergone a series of road tests with a dynamometer car. These tests were conducted over various sections of track, on grades and at speed to establish the maximum capacity of the locomotive with reference to boiler evaporation, tractive effort and horsepower. The maximum speed at which speed tests were conducted was 70 miles per hour, with a load of 500 tons and the maximum grade over which the tests were carried out was 1 in 45 with 10 chain uncompensated curves.

The speeds, grades and loads selected for tests gave a complete range of conditions to enable the maximum tractive effort, horsepower and mechanical efficiency to be established at speeds from 10 to 70 miles per hour. To enable maximum horse-power at 70 miles per hour to be developed the train resistance was increased by applying the brakes on the test train from a special control valve fitted on the dynamometer used in conjunction with the E.T. brake equipment of the locomotive. This enabled the maximum load hauled to be increased from a trailing load of 500 tons to an equivalent maximum of 675 tons.

The tractive effort curves which have been developed from this test indicate that the locomotive is capable of sustaining a higher tractive effort at speed than is normally obtained from an engine with cylinders of this capacity and the maximum indicated horsepower of 2600 developed at 70 miles per hour is considered a very satisfactory achievement for an engine of this size.

Various other efficiency tests were conducted at the same time with fuel and water consumption as against total work done in millions of foot Ibs. and has shown a saving in both fuel and water when compared with other classes of modern power on these Railways indicating a high boiler and mechanical efficiency.

The performance of this locomotive, both from its capacity to handle the train load and its economy in fuel and water and its steady riding qualities, has made it the most efficient locomotive in service with the South Australian Railways.